#273

PIFSC Library

SURVEY OF THE FISHERIES OF THE FORMER JAPANESE MANDATED ISLANDS

LIBRARY
Pacific Islands Fisheries Science Center
2570 Dole St.
Honolulu, Hawaii 96822-2396

FISHERY LEAFLET 273

FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF INTERIOR

Digitized by the Internet Archive
in 2025

https://archive.org/details/fishery-leaflet_1947-10_273

FOREWORD

This survey of the fisheries of the former Japanese mandated islands of the Pacific Ocean was a part of the general economic survey undertaken by the Pacific Ocean Division of the United States Commercial Company, Reconstruction Finance Corporation, at the request of the Navy Department.

Shortly after the close of hostilities in the Pacific, the Navy recognized that its responsibility for administering the Marianas, Carolines, and Marshalls, extended beyond the mere establishment of law and order, or even the physical rehabilitation of war-torn areas. By and large, the Micronesians were not enemy aliens, but rather innocent bystanders who had suffered heavy losses in life and property through no fault of their own. For the most part, they were eager to adopt the American way of life, including radios, movies, motor boats and vehicles.

Viewed in the cold light of economic realism, it is obvious that the majority of these rosy dreams are impossible of fulfillment. The hard fact is that in the end, their relative prosperity depends on the movement of their own materials or products to world markets, with an accompanying return flow of goods and manufactured articles. Otherwise, we must assume that the native population will be kept in much the same status as the bison of Yellowstone Park.

The foremost question then is what natural resources exist for home consumption and for export. It was to answer this question, so long shrouded in secrecy by the Japanese, that the Economic Survey was undertaken.

Originally, it was intended that all reports of survey specialists would be published in a single coordinated series, with a general introduction to provide the background material for all. That plan having been abandoned, it was necessary to add some general information to the Fisheries report. Also, it has not been possible to incorporate in this report the data on local fisheries of Truk, Ponape, and the Marshall Islands, collected by economists assigned to those areas.

In order that the results of the fisheries survey might be made available to the public at the earliest moment, a condensed version was published by the Fish and Wildlife Service under the title "Fishery Resources of Micronesia", Fishery Leaflet No. 239, May, 1947. The present paper now supersedes Fishery Leaflet 239, and contains all of the data on which the condensed version was based.

It is a pleasure to acknowledge indebtedness for many services rendered by personnel of the U. S. Commercial Company, Economic Survey, and Naval Military Government in Washington and the field, and by the Director and staff of the Bernice P. Bishop Museum in Honolulu.

Last, but not least, the author wishes to congratulate himself for having as assistant, Mr. Anthony Aki, of Honolulu, master swimmer, diver, and throw-net fisherman, who not only did an excellent job of field collecting, but also accomplished wonders with limited galley equipment.

TABLE OF CONTENTS

		Page
	INTRODUCTION	1
	A. General Description of the Area	1
	B. Scope and Methods of the Survey	2
Part I	FIELD SURVEYS BY ISLAND GROUPS	5
	I. THE MARSHALL ISLANDS	
	RALIK CHAIN	5
	A. Eniwetok Atoll	5
	B. Kwajalein	7
	C. Ailinglaplap	7
	D. Jaluit Atoll	10
	RATAK CHAIN	13
	A. Likiep	13
	B. Majuro Atoll	13
	II. THE CAROLINE ISLANDS	18
	A. Kusaie Island	18
	B. Ponape Island	20
	C. Nukuoro Atoll	24
	D. Kapingamarangi Atoll	25
	E. Truk Islands	30
	F. Palau Islands	39
	1. Peleliu	39
	2. Koror	39
	3. Kayangel Islands	48
	III. THE MARIANA ISLANDS	50
	A. Saipan Island	50
	B. Tinian Island	52
	C. Rota Island	55
	D. Guam Island	56
Part II	DESCRIPTION OF THE FISHERIES	58
	INTRODUCTION	58
	I. BONITO INDUSTRY	59
	A. Statistics of the Bonito Fishery	59
	B. The Japanese Bonito Fishery	64
	C. Native Bonito Fishery on Saipan	64
	D. Preparation of Dried Bonito Stick-Japanese Method	69

		Page
II.	THE JAPANESE TUNA FISHERY	70
III.	SPONGE CULTURE	70
	A. Native Sponges	70
	B. Japanese Sponge Culture at Ailinglaplap	71
IV.	PEARL SHELLS	72
	A. Distribution of Pearl Shells	72
	B. Japanese Pearl Culture at Ebon	73
V.	SEA CUCUMBERS (TREPANG)	73
VI.	TROCHUS SHELLS	75
VII.	FISHERIES OF TRUK	75
	A. Information on Pre-war Fishery	75
	B. Trepang Fishery at Truk	76
	C. Trochus Shell Fishery at Truk	76
VIII.	SAIPAN BEACH SEINING	78
IX.	SEA TURTLES	79
X.	POISON FISH	79
Part III	SUMMARY AND RECOMMENDATIONS	82
	A. SUMMARY	82
	1. General Summary	82
	2. Information on Fishing Supplies	82
	3. Construction of Native Vessels	83
	B. RECOMMENDATIONS	83
	1. Immediate	83
	2. Subsequent	85
	C. RECOMMENDATIONS FOR GUAM FISHERIES	88
	1. Commercial and Sport Fishing	88
	2. Fishing Vessels	88
	3. Special Fishing Regulations	88
	4. Japanese Fishing Hampered by Sharks	88
Part IV	NATIVE NAMES RELATING TO THE FISHERIES	89
	REFERENCES	98
	INDEX	100

Figure 1... Tinian. Spreading a 14 ft. throw-net from a coral reef. June 1946.

ILLUSTRATIONS

Figure		Page
1	Tinian. Spreading a 14 foot throw-net. June, 1946	iv
2	Kusaie. Hand net (Epino) used by women. August, 1946	8
3	Jaluit. Paddling and sailing canoes. August, 1946	8
4	Majuro. Short spear. August, 1946	14
5	Jaluit. Sailing canoe. August, 1946	14
6	Kusaie. Trolling (heavy) and still-fishing lines. August, 1946	14
7	Kusaie. Throw-net. August, 1946	16
8	Kusaie. Method of holding throw-net. August, 1946	16
9	Kusaie. Paddling canoe. August, 1946	16
10	Kusaie. 4-prong spear. August, 1946	17
11	Kusaie. Samoan Crab (Scylla serrata). August, 1946	17
12	Kapingamarangi. Canoe house, lagoon side. August, 1946	26
13	Nukuoro. Paddling canoe. August, 1946	26
14	Kapingamarangi. Fish spear. August, 1946	26
15	Kapingamarangi. Stone fish trap, low tide. August, 1946	27
16	Kapingamarangi. Sailing canoes. August, 1946	27
17	Kapingamarangi. Paddling canoe and scoop-net for flying fish. August, 1946	28
18	Kapingamarangi. Detail of fish traps. August, 1946	28
19	Truk. Short fish spear. May, 1946	31
20	Palaus. Terrain between Koror and Pelelieu. July, 1946	37
21	Palaus. Typical undercut cliffs on islands between Koror and Pelelieu. July, 1946	37
22	Palaus. Koror Island. Site of Japanese Marine Fisheries Experiment Station. July, 1946	38
23	Palaus. Koror. Bombed Japanese bridge blocking navigation. July, 1946	38
24	Palaus. Koror Island. Giant clam shell. July, 1946	40
25	Palaus. Near Koror. Spear fishing inside barrier reef. July, 1946	40
26	Palaus. Koror Island. Paddling canoe. July, 1946	40
27	Palaus. Koror Island. Spiny Lobsters. July, 1946	41
28	Palaus. Near Koror Island. One man's catch, two hours of spear fishing. July, 1946	41
29	Palaus. Near Koror Island. 25 pound blue wrasse from outer reef. Taken with spears. July, 1946	41
30	Palaus. Koror Island. Bonito and Crevalle taken on spoon. July, 1946	43
31	Palaus. Koror Island. Types of trepang produced by natives. July, 1946	43
32	Palaus. Koror Island. Equipment for culturing pearls. July, 1946	44
33	Palaus. Koror Island. Baskets holding black-lip oysters for pearl culture. July, 1946	44
34	Palaus. Kayangel Island. Jig made from stalk of spider lily. July, 1946	47
35	Rota. Area between shore and fringing reef. Low tide. June, 1946.	47
36	Guam. Blue wrasse taken with surround net, near Merizo. June, 1946	57
37	Truk. Japanese fishing sampan. May, 1946	62

ILLUSTRATIONS (Continued)

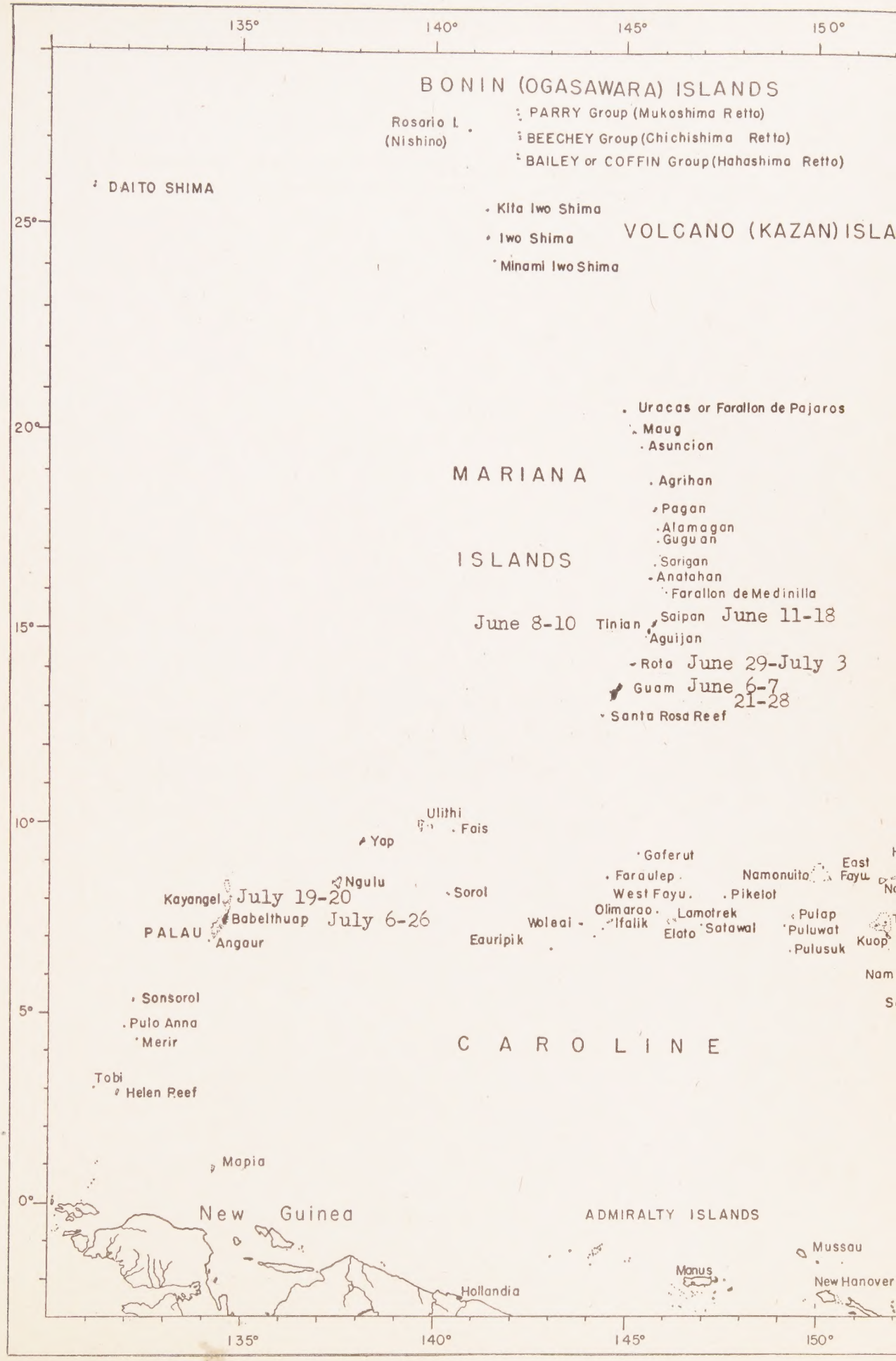
Figure		Page
38	Saipan. Bonito fishing. No. 1. Laying out live-bait net. June, 1946	63
39	2. Driving live-bait into net. June, 1946	63
40	3. Drying-up live bait net. June, 1946	65
41	4. Bailing live-bait from net to tanks. June, 1946	65
42	5. Detail of live-bait and tanks. June, 1946	65
43	6. Salt water sprayer. June, 1946	66
44	7. Method of fishing. June, 1946	66
45	Ailinglaplap. Anchor and float for sponge culture. August, 1946	71
46	Truk. Native produced Trepang (dried sea-cumbers) August, 1946	74
47	Truk. Trochus shells. May, 1946	74
48	Saipan. Beach seining No. 1. Setting net. June, 1946	77
49	2. Hauling net. June, 1946	77
50	3. Catch (mostly 4 to 5 inch goat-fish) June, 1946	78

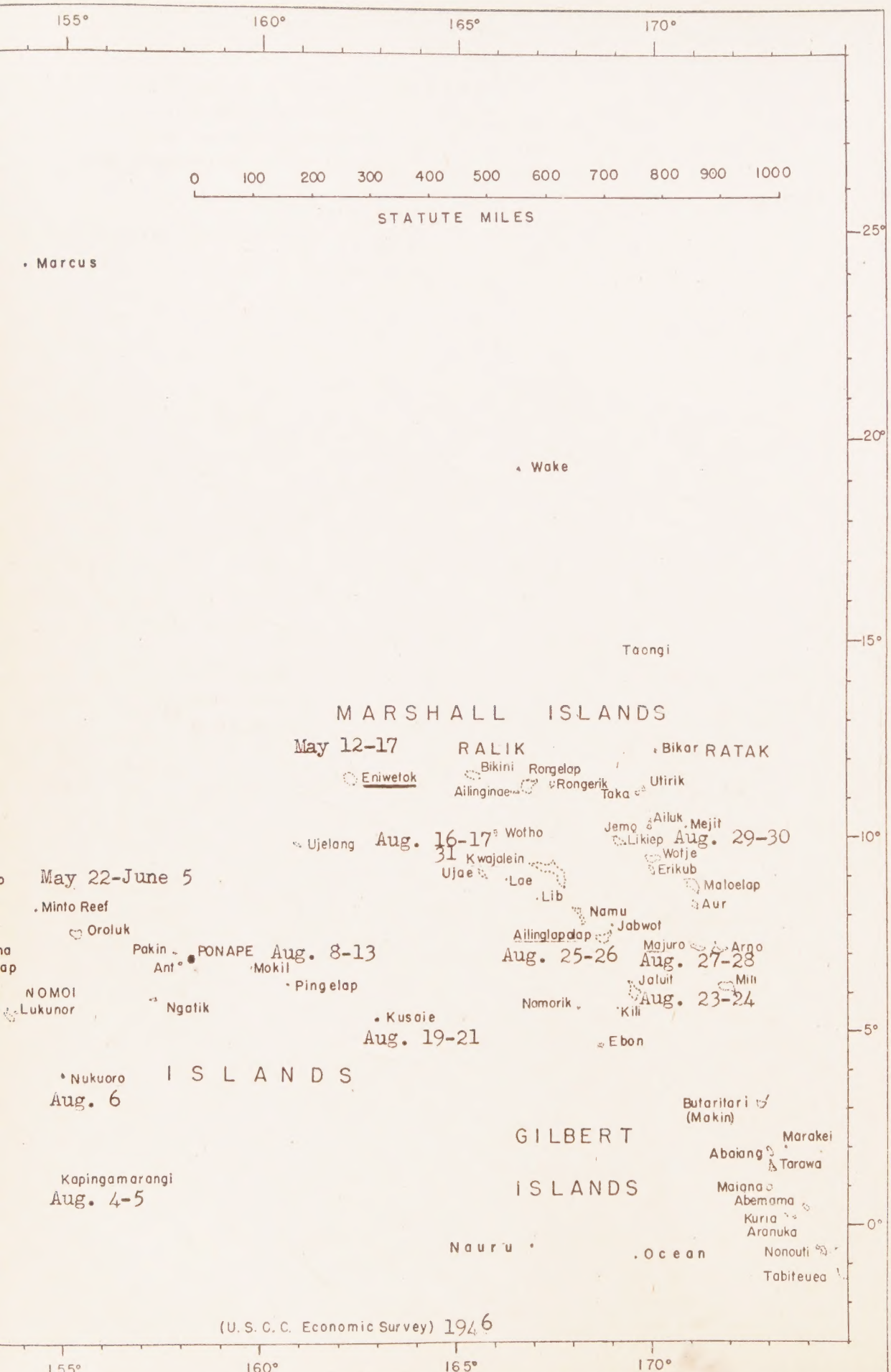
MAPS

The Mandated Area	Facing 1
Eniwetok Atoll, Marshalls	Facing 5
Ailinglaplap Atoll, Marshalls	6
Kwajalein Atoll, Marshalls	Facing 7
Jaluit Atoll, Marshalls	9
Likiep Atoll, Marshalls	11
Majuro Atoll, Marshalls	12
Kusaie Island, Carolines	17
Ponape Island, Carolines	19
Nukuoro Atoll, Carolines	23
Kapingamarangi Atoll, Carolines	23
Truk Group, Carolines	29
Kuop Atoll, Carolines	31
Palaus, General chart, Carolines	34
Palaus, No. 1, Kayangel Islands	34
Palaus, No. 2, Babelthuap Island	35
Palaus, No. 3, Koror to Pelelieu	36
Saipan, Marianas	49
Tinian, Marianas	51
Rota, Marianas	53
Guam, Marianas	54

TABLES

Figure		
1	Bonito Catch - Japanese Mandate Islands, 1934-41	60
2	Prices of Fresh Bonito, 1934-41	60
3	Weight Relation, Bonito Sticks to Fresh Bonito	60
4	Number of Fishing Vessels in the Mandate Islands, 1937	61
5	1941 Catch & Production - Mandated Islands	61


135°
140°
145°
150°
BONIN (OGASAWARA) ISLANDS
PARRY Group (Mukoshima Retto)
BEECHEY Group (Chichishima Retto)
BAILEY or COFFIN Group (Hahashima Retto)
Rosario I. (Nishino)
DAITO SHIMA
Kita Iwo Shima
Iwo Shima
Minami Iwo Shima
VOLCANO (KAZAN) ISLA
25°
Uracas or Farallon de Pajaros
Maug
Asuncion
MARIANA
Agrihan
Pagan
Alamagan
Guguan
ISLANDS
Sarigan
Anatahan
Farallon de Medinilla
20°
June 8-10
Tinian
Saipan
June 11-18
Aguijan
Rota
June 29-July 3
Guam
June 6-7
21-28
Santa Rosa Reef
15°
10°
Ulithi
Fais
Yap
Ngulu
Sorol
Kayangel
July 19-20
Babelthuap
July 6-26
PALAU
Angaur
Eauripik
Woleai
Goferut
Faraulep
West Fayu.
Olimarao
Ifalik
Lamotrek
Elato
Satawal
Pikelot
Namonuito
East Fayu
Pulap
Puluwat
Pulusuk
Kuop
5°
Sonsorol
Pulo Anna
Merir
C A R O L I N E
Tobi
Helen Reef
Mapia
0°
New Guinea
ADMIRALTY ISLANDS
Manus
Mussau
New Hanover
Hollandia
135°
140°
145°
150°



(U. S. C. C. Economic Survey) 1946

United States Department of the Interior, J. A. Krug, Secretary
Fish and Wildlife Service, Albert M. Day, Director

Fishery Leaflet 273

Washington 25, D. C. October 1947

SURVEY OF THE FISHERIES OF THE FORMER JAPANESE MANDATED ISLANDS

By Robert O. Smith
Aquatic Biologist, Office of Foreign Activities,
Fish and Wildlife Service.

INTRODUCTION

A. GENERAL DESCRIPTION OF THE AREA

In evaluating the fisheries resources of the former Japanese Mandated Islands of Micronesia, two facts must be kept in mind. The first is that a relatively small amount of land (902.5 sq. mi.) is widely distributed over a considerable area of the central north Pacific Ocean. The second fact is that we are dealing here with a total native population of only 70,000 people. On a comparative scale, the land area is 3/4 that of Rhode Island and the total native population is about 1/4 that of Honolulu. Only by constantly keeping these two facts in mind can we maintain a realistic approach to the problems involved.

The Japanese mandate comprised all of the Marshall, Caroline, and Mariana Islands, with the exception of Guam, which had, of course, been United States Territory under the jurisdiction of a naval governor since the Spanish-American war. These island groups contain more than 2,100 islands and islets of varying sizes, extending over a total area of ocean approximately the size of the United States (see General Map). The native population is not distributed evenly throughout this area, but tends to concentrate at a few points.

We must also avoid a tendency to confuse the Japanese exploitation of the commercial fisheries with the subsistence fishing of the native population. Except in a very few places (Palaus, Saipan, Truk, Ponape) where there was a large Japanese commercial fishery from which small amounts of surplus catch were funneled off to the natives, the basic pattern of native subsistence fishing remains approximately the same now as it did prior to the Japanese mandate. Neither the Spanish nor the German regimes, which preceded the Japanese, could profitably use in their economy the fishery products from Micronesia, and so made no effort to exploit them. Exports were limited to small amounts of trochus, pearl, and tortoise shells.

Under Japanese mandate the decade from 1920 to 1930 was one of general inquiry to determine the kinds of marine resources present. Actual production for export to Japan was negligible. Beginning with 1930, the tonnage exported to Japan increased steadily until halted by the imminence of war. Highest production of bonito was apparently in 1937, when over 75,000,000 pounds were produced. Insofar as the abundance of fish is

concerned, there is reason to believe that production had not reached a maximum. Exported processed food products consisted chiefly of dried bonito, dried tuna, canned fish, and trepang, amounting altogether in 1937 to slightly over 6,000 metric tons. Compared with total production in the Japanese Empire, fisheries products from the mandated area were valued at less than two percent.

The natives had little part in this developing industry. Okinawan fishermen manned the fishing vessels and Japanese operated processing plants and facilities on shore. There is no record of a native crew being permitted to operate a Japanese fishing vessel in the offshore fishery. After the outbreak of war the natives were not allowed to go outside the lagoons.

However, the important place of sea foods in the native diet can scarcely be over-emphasized. It is the beef and pork of Micronesia. Even at the highest levels of meat production which existed prior to the war, fish was the main protein, eaten at least once daily, generally oftener. Chicken and pig, though fairly abundant were mostly eaten at feasts. Shortages brought on by the war, mainly Japanese inability to replenish their own supplies, have now reduced the live stock to so low a number that in most places, even feasts depend largely on sea food.

It is not surprising that this should be so, for normally fish and shell-fish are easily taken on the flat, shallow reefs along shore; on the barrier and fringing reefs around the islands, and in the lagoons of atolls. The supply has always been available in return for a few hours of pleasant recreation, needs no cultivation, and is even frequently eaten raw, eliminating the labor of preparation.

This happy condition has been badly affected by war. Native canoes were destroyed by Japanese to prevent escape or contact with United States forces. Almost every family formerly had one canoe, often more. Without water transportation, fishing is limited to the shoreline, where the catch is mostly small immature fish and shell fish. The greatest shortage is in the Palaus, where only 80 canoes were left out of 1500.

A second and equally serious shortage exists in fishing supplies, and this is universal in the ex-mandate. Formerly, large quantities of Japanese hooks, feather lures, jigs, nets, seine twine and fish line were obtainable. Stocks on hand have been exhausted and American supplies have been slow in coming.

The third factor limiting native subsistence fishing is reduction of fish and shell fish on inshore reefs by Japanese dynamiting. Many Japanese garrisons found it necessary to procure sea food to offset food shortages when their supply lines were cut. The most efficient method of capture for them was use of explosives. Though no permanent damage should result, temporary fish and shell fish shortages exist which are aggravated by the shortages of vessels and supplies mentioned above.

Another point worthy of mention is that except in the Palaus, various species of fish are poisonous in varying degrees from slightly to deadly. Natives, of course, know the edible quality of each fish in their home waters, and fish poisonings more severe than moderate gastric disturbances are rare.

B. SCOPE AND METHODS OF THE SURVEY.

The primary purpose of the Economic Survey was to promote the welfare of the native population. The Survey was expected to establish a factual background for use by administrative officers.

In order to accomplish this, the study of fishery resources was divided into two

main categories, the first consisting of what may be called day to day, or subsistence fishing, mainly carried on inside the barrier reefs; while the second is offshore, or commercial fishing, of a magnitude much greater than required for the support of the local population. For its full development, this type of fishing demands an investment in vessels, equipment, and shore facilities far beyond the means of the natives to provide, consequently less time was devoted to it during the survey. Emphasis has been placed on describing local conditions at each island visited, the most abundant kinds of sea-food and sea-products present, the boats and fishing gear owned, and the mehtods used in subsistence fishing. Shortages in food, equipment and supplies have been noted with recommendations. Suggestions have been made for conservation measures as seemed to be required in the light of present knowledge.

Field work extended over the period May 2-August 31, 1946. Unless otherwise indicated, all dates or references to time should be understood to fall within the above limits.

An LCI (Landing Craft Infantry No. 983) was made available by the Navy for transportation of the Survey party, and this was used between Pearl Harbor and Truk, via Eniwetok, on the outgoing trip, and inbound from Truk to Kwajalein, via Kapingamarangi, Nukuoro, Ponape, Kusaie, Jaluit, Ailinglaplap, Majuro and Likiep. Elsewhere, travel was by Naval Air Transport Service. Points reached, and dates of arrival and departure, are shown on the general map facing page 1. In the Field Survey section, local charts are marked to show the localities examined and fishing methods used.

Since much of the travel between islands and island groups was by plane, fishing equipment was limited to hand lines, feather lures, spoons, spears and throw-nets, with a total weight of 80 pounds. This gear was satisfactory, as the natives had seines for use at the relatively few places such fishing was possible.

At each point visited, information on the fisheries was collected in two ways: by interviews with fishermen, chiefs, scribes, and any other persons having a knowledge of local conditions, past and present; and by examination of as many fishing localities as time permitted. Where stops were of only two days duration, one was spent ashore holding conferences and examining fishing gear, while the other was devoted to fishing.

Barrier and fringing reefs on the seaward side, and reefs on the lagoon side of islands were examined by diving; on shallow flats, throw-nets and hand picking were used; battle lanterns were used under water at night for examining both reefs and flats in depths not over two fathoms; trolling was done in lagoons, passes, and just outside the breakers of barrier and fringing reefs. Local transportation usually was by out-rigger canoe, with fishermen as guides and assistants.

Additional information was obtained from the area economists of the survey, who made intensive studies of limited portions of the ex-mandate.

Because of the extensive collections of marine organisms already made by Operation Crossroads, and others, museum collecting was omitted from the agenda of this survey, but it could not have been done anyway without curtailing more important phases of the program. An unsuccessful attempt was made to bring back some specimens in a home-type quick freezer.

ITINERARY

May, 1946

2	1200 Left Pearl Harbor on LCI (L) 983
12	Arrived Eniwetok, Northwest Marshalls
17	Left Eniwetok (LCI)
22	Arrived Truk, Central Carolines

June

5	Truk to Guam (by air - R5D)
7	Guam to Saipan by air (Marianas)
7	To Tinian by boat
8-9	On Tinian (Marianas)
10	Tinian to Saipan by boat
11-18	Saipan (Marianas)
19	Saipan to Guam by air
20-28	Guam (Marianas)
28	Guam to Rota by air
29-30	On Rota (Marianas)

July

1-3	On Rota (Marianas)
4-5	Guam awaiting transportation to Palaus
5	Guam to Pelelieu by air
6-26	Palaus and Kayangel Ids. (Western Carolines)
27	Pelelieu to Guam by air
29	Guam to Truk by air
30-31	Truk (Central Carolines)

August

1-2	Truk
2	Truk to Kapingamarangi by LCI
4-5	Kapingamarangi (LCI) (Southeastern Carolines)
6	Nukuoro (LCI)
8-13	Ponape LCI (Eastern Carolines)
16-17	Kwajalein to refuel (LCI) (Central Marshalls)
19-21	Kusaie (Eastern Carolines) (LCI)
23-24	Jaluit (Southern Marshalls) (LCI)
25-26	Ailinglaplap (Southern Marshalls) (LCI)
27-28	Majuro (Southern Marshalls) (LCI)
29-30	Likiep (East Central Marshalls) (LCI)
31	Kwajalein (LCI) Arrived 1000
31	Left Kwajalein by NATS for Honolulu 2300
31	Arrived Honolulu 1300

PART I FIELD SURVEYS BY ISLAND GROUPS

I. THE MARSHALL ISLANDS
RALIK CHAIN

A. ENIWETOK ATOLL (Population 139 - 1946)
(May 14-18)

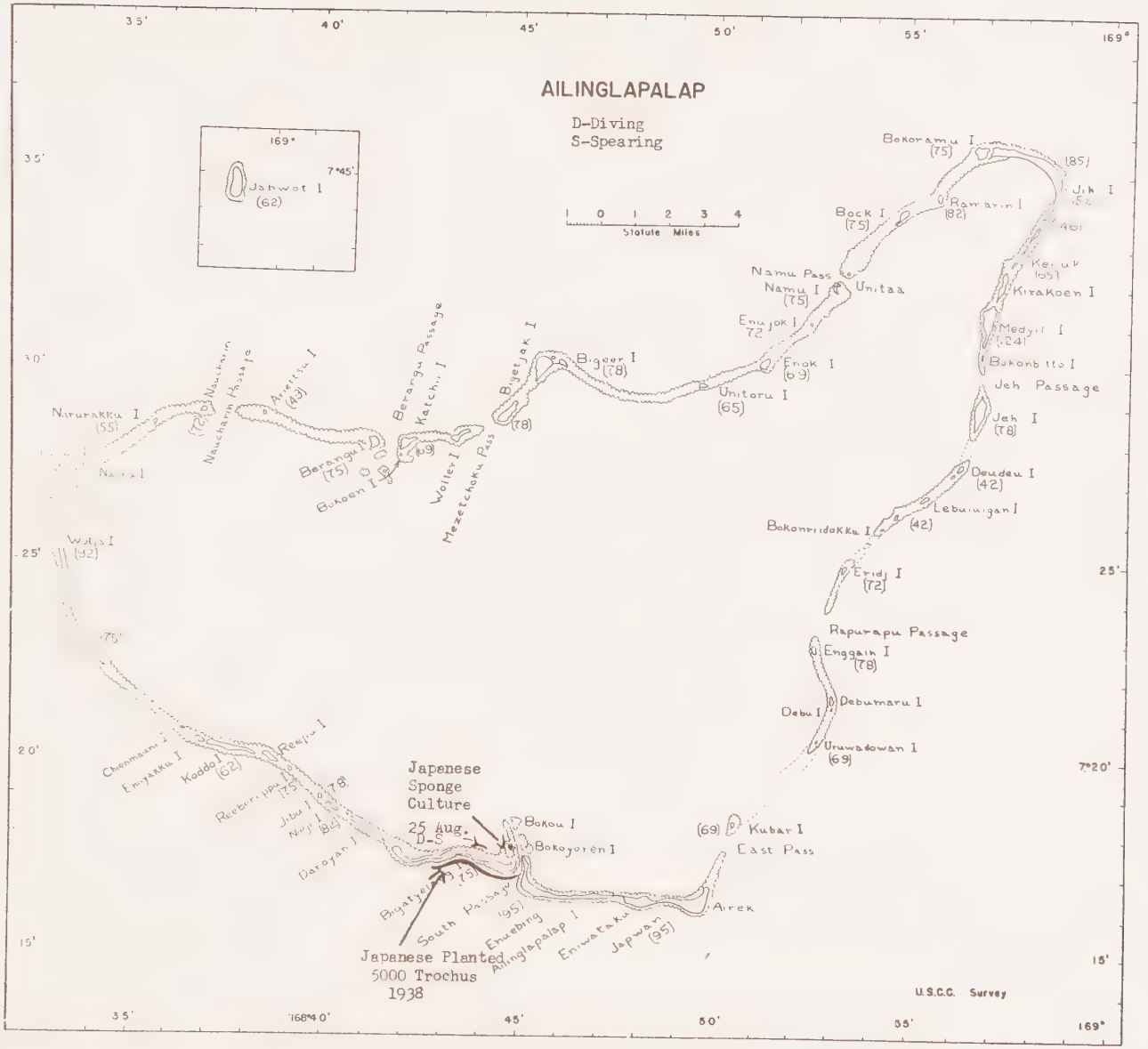
There was no opportunity to troll offshore during the stay at Eniwetok, and in any case it is believed that the status of offshore fisheries will have been determined very thoroughly by the fishery scientists attached to Operations Crossroads. Both reef and inshore fishes were very abundant throughout the atoll, so that the small number of natives were not likely to exhaust the supply with the methods of fishing available to them. As an example of the abundance of fish generally present, 81 goatfish (Mulloidichthys auriflamma Forskal) were taken with one cast of the 14-foot radius throw net. These weighed approximately half a pound each. On another throw with the 12-foot radius net, threadfish (Polydactylus sexfilis) and four mullet (Mugil cephalus) were taken. These catches were made on the seaward side of Igurin Island, between the fringing reef and shore, in depths of one to two feet. Small black-tipped sand sharks (Eulamia melanopterus), two to five feet in length, were common in shallow water. Also abundant were small orange-striped crabs (Grapsus grapsus tenuicrustatus). These crabs were boiled and eaten by the Marshallese. From the number of empty shells observed, it is evident that the spiny lobster or crawfish (Panulirus marginatus Quoy & Gaimard) is abundant in the area.

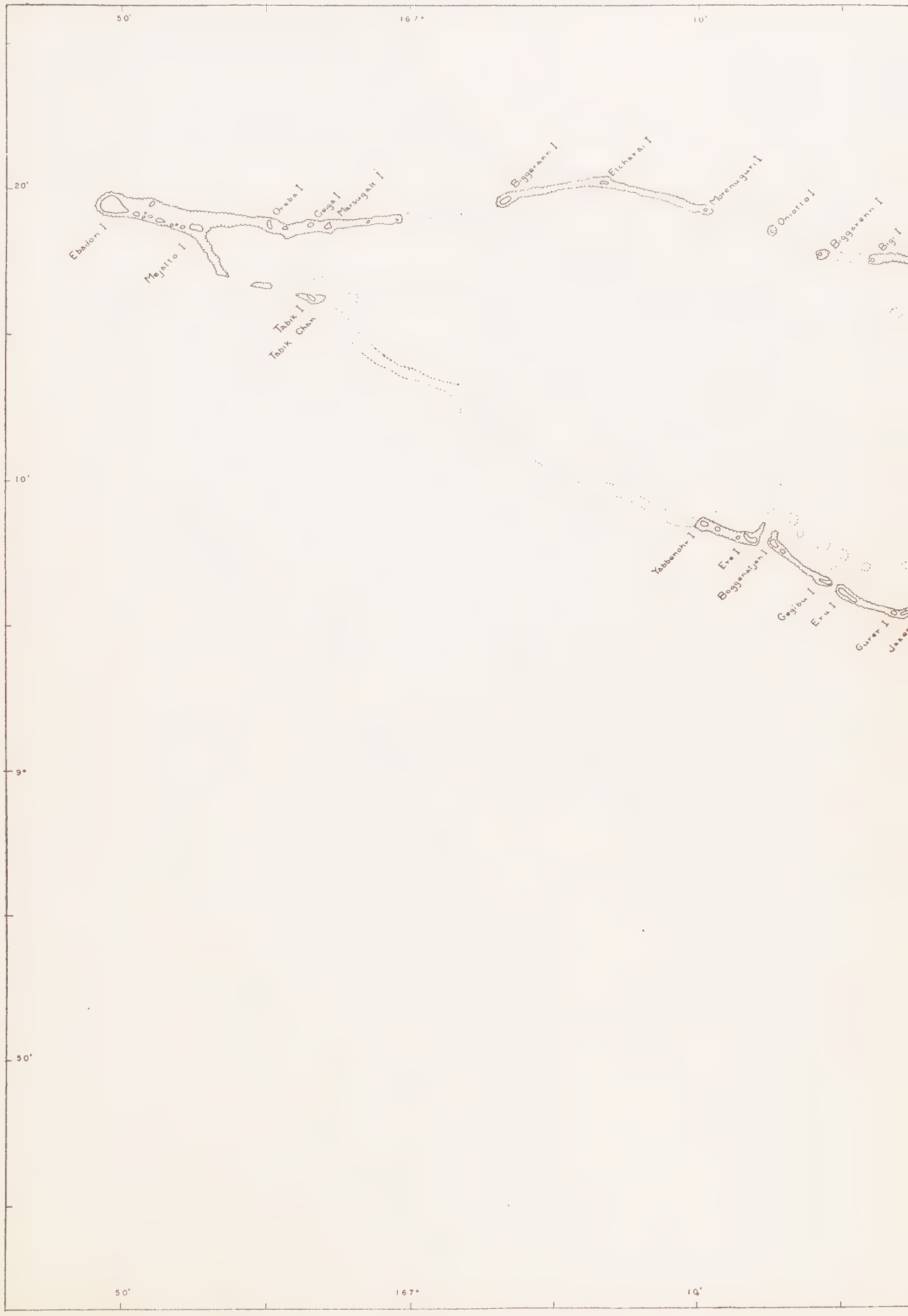
On account of the coral heads, beach seining would be impossible. There were places, however, where a type of surround net could be used. On the lagoon side of Japtan Island there was a fairly flat coral ledge, suitable for throw-netting (Fig. 1), but too rough for beach seining.

There were no edible seaweeds (Codium sp.; Gracilaria sp.; Laurencia sp.) on either Japtan or Igurin Islands. A few small bait fish, an anchovy of the kind called "nehu" in Hawaii (Anchoviella purpureus), were seen around the islands, but not in sufficient quantity to supply a commercial fishery. In place of these, the very abundant small goatfish could be used.

Several species of small decorative shells were common in shallow water under rocks along the shores of all of those islands of the atoll. The commonest ones were the "monkey face" (Cypraea moneta). The "gold ringer" (Pustularia annulus) and the "strawberry" or "bleeding heart" (Pustularia (Erosaria) Helvola). Several species of cowries, particularly the tiger shell (Cypraea tigris) and Cypraea caputserpentis were abundant on the ocean side of the reefs. The small shells mentioned provide an income to the natives, who make them into necklaces, bracelets, and head bands for sale to military and civilian personnel; the prices charged by the natives range from a dollar, for a necklace made of the monkey face, to $2.00 for one of gold ringer, and $5.00 for one of the bleeding heart or strawberry. The tiger cowrie shells are generally sold for 25 cents each.

All of the natives were concentrated on Aomon Island. Subsequently, they were moved away as a safety precaution in preparation for the first test of the atomic bomb. Two species of the giant clam (Tridacna gigas and Tridacna elongata) are abundant and are eaten by the natives--usually raw, but sometimes made into chowder. In addition to the species already mentioned, the natives obtain and eat in quantity rudderfish (Kyphosus sp.), several species of goat-fish (Mulloidichthys sp.) and (Pseudupeneus sp.), trigger fish (Balistes & Balistapus sp.), surgeon fish (Hepatus sp.), and octopi (Polypus sp.).


AILINGLAPALAP
D-Diving
S-Spearing
1 0 1 2 3 4
Statute Miles
Jahwat I
(62)
Bokoramu I
(75)
(85)
Jih I
Ramarin I
(82)
Bock I
(75)
Namu Passage
Namu I
(75)
Unitaa
Enujok I
(72)
Kerub
(55)
Kitakoen I
Medyu I
(124)
Bokonbito I
Jeh Passage
Jeh I
(78)
Deudeu I
(42)
Lebuwigan I
Bokonridokku I
(42)
Eridi I
(72)
Rapurapu Passage
Enggain I
(78)
Debumaru I
Debu I
Uruwadowan I
(69)
Bigaar I
(78)
Enok I
(69)
Unitoru I
(65)
Bigetjak I
(78)
Naturakku I
(55)
Nauchanin Passage
Arielsu I
(43)
Berangu Passage
Katchu I
Berangu I
(75)
Bukoen I
(69)
Woller I
Mezetchoku Pass
Wotje I
(92)
Chennaanu I
Enyakku I
Koddo I
(62)
Reeju I
Japanese
Sponge
Culture
25 Aug.
1938
Bokou I
Bokoyoren I
(69)
Kubar I
East Pass
Airek
Japwa I
(95)
Enwarakku
Ailinglapalap I
Enuebing
South Passage
(95)
Bigatyen I
(75)
Daroyan I
Japanese Planted
5000 Trochus
1938
U.S.C.G. Survey
35'
40'
45'
50'
55'
169°
7°45'
7°20'
25'
20'
15'
30'


50'
167°
10'
20'
10'
9°
50'
50'
167°
10'
Ebadon I
Mejatto I
Oreba I
Gegal I
Marugalt I
Tabik I
Tabik Chan
Baggerann I
Etcharar I
Morenugiri I
Onotto I
Baggerann I
Bgr I
Yabbenahr I
Ere I
Boggenaljen I
Gegibu I
Eru I
Gurer I

KWAJALEIN
1 0 1 2 3 4
Statute Miles
T-Throw Net
20'
30'
40'
15'
10'
5'
9°
50'
Roi I
Namur I
North Pass
Emwaeting I
Obella I
Ledyggen I
Dabuk I
Ledjell I
Logan I
Baggerik I
Takamushikan I
Nell I
Gallinam I
Omelek I
Enwetakku I
Kwadack I
Mack I
Eller I
Ambo Chan
Legan I
Mann I
Torrutj I
Bigej I
17 Aug.
T
Bigej Chan
Gugegwe I
Gehh I
Ninni I
Gea I
Loi I
Ennylabegan I
South Pass
Ebeye I
17 Aug.
Enubuj I
Kwajalein I
U.S.C.G. Survey

At the eastern end of Piiraai Island there is a native coral stone semi-circular fish trap into which the natives drive schools of goat-fish and other small species.

In view of the abundance of fish and shell fish around Eniwetok, it seems unnecessary to recommend any change or attempted improvement in native fishing methods, as they are able to supply subsistence needs by only an hour or so of fishing per day. Several of the natives were given an opportunity to use the sling type spear of Hawaiian design and also our large throw nets, but other than the novelty of it, they did not appear to be interested. Their own spears are homemade, without barbs, and are set in a wood handle, the overall length of spear and handle being between six and seven feet. They do not have throw nets. Fish hooks were very scarce.

B. KWAJALEIN (Population 751 - 1946)
(August 16-17)

The islands of this low and sandy atoll resemble Eniwetok very much in having an abundance of fish on both the lagoon and seaward in shallow waters. Small goat-fish (Pseudupeneus) up to eight inches and striped surgeon fish (Hepatus triostegus), about seven inches long, are very abundant and easily taken with throw nets. Outside the reef, crevalle (Caranx sp.), up to ten pounds, are also quite common, but wild. They could be taken by trolling or handlining just outside the breakers. At the time of the survey, there was not even subsistence fishing to any extent, for very few natives were left in the vicinity of Kwajalein because of the atomic bomb experiments. Most of those left are employed by, and receive subsistence from, the Navy, and do not fish for a living.

C. AILINGLAPALAP ATOLL (Population about 1200 - 1946)
(August 25-26)

Pigatyelang Island. The reef on the lagoon side is very rough, with many caverns, and drops abruptly to three or four fathoms. Outside of the reef a few coral heads extend from the bottom to within a fathom of the surface. Within this area reef-fishes are very abundant, although wild and difficult to get close enough to for spearing. Among the commonest species are red and blue parrot fish (Callyodon sp.), several species of surgeon fish (Hepatus sp.), butterfly fish (Chaetodon sp.), and Moorish idols (Zanclus canescens). There were also many small giant clams up to 12 inches. Sea cucumbers (Holothuria) were rare. The natives stated that the Japanese looked into the possibility of producing trepang (dried sea cucumbers), but found that the supply of sea cucumbers was not sufficient to warrant it. The Japanese planted 5,000 trochus shells on the outside reef on the seaward side in 1938. The planting was done by Okinawan fishermen who came one day, planted the shells, and left immediately. The shells were dumped over the side of the boat and none has been harvested (to September, 1946) by the natives, as there has been no market for them during the war years. Trochus shells (Trochus niloticus) are not used for food by the natives, consequently almost the total number planted should be available, plus the natural increase since 1938. These shells should not be harvested until June 1947, when all of the shells of good quality over three inches in diameter should be harvested.

Since there are around 1,200 people on these islands and only a few pigs and chickens, the inhabitants must depend largely on fishing for their protein food. The men go fishing practically every day. They formerly had throw nets, but due to the war these are now worn out, and there is no twine for replacement. The natives depend mainly on spears and on collecting small giant clams (Tridacna) and other shell fish. For the entire population there are only two short seines of about two inch square mesh, and an average of one fish hook for ten men. Turtles are quite rare here and are only a minor item in the diet. Although most of the fishing is done by men, the women sometimes use small hand nets (Fig. 2) to catch small fish on the reef. The natives formerly used feather lures for trolling from

their canoes outside the reef, but at the present time they have so few hooks that this is out of the question. They need feather lures, spoons, hooks of all sizes, lead to make sinkers, leader wire, swivels, fishing twine for hand lines, seine twine for making nets and for knitting throw nets; also canvas and miscellaneous marine hardware for their sailing canoes.

During the Japanese occupation, sampans operated from Ailinglapalap and obtained enough dried bonito for limited export, as well as supplying the Japanese garrison and local population with fresh fish. The sampans belonged to an Okinawan fishing company.

The Japanese undertook sponge culture in 1937-38, a description of which will be found in the section on Fisheries (Part III-IVB).

Left, Fig. 2.. Kusaie.
Hand Net used by women.
August 1946.

Right, Fig. 3.. Jaluit.
Paddling and sailing canoes.
August 1946.

JALUIT
1 0 1 2 3 4
Statute Miles
Boggenadick I
Ren I
Namoren I
Urbett I
Bogenaga I
Shabunaren I (85)
Regeran I
Gusen I
Namoraru I
Kaishin I
Nalmedj I
Aenumin I
Nanishi I
Ngain I (55)
Pekeshie I
Rebjeru I
Ljeron I
Chinibaru I
Kiikan I
Pikyjin I
Medyai I
Rua I (33)
Remoraru I
Bogoraborapu I
Medyado I (88)
Aug.23 (night)
Ribon I (52)
Northeast Pass
Aug.24
Trolled Aug.23, p.m.
Anboru I (78)
Agidyen I
Rere I
Enimomu I
Tmiet I
East Pt
Emidj I (85)
Harappu I (75)
Dagaya I (75)
West Pt
Pinglap I
Aineman I
Bokaryman I (65)
Kabbenbock I
Enybor I (92)
Southeast Pass
Aruboe I (82)
Jabor I
Sydney Rer
Aug.23, a.m.
Namotamu I (88)
Pokoribiya I
Ai I
Southwest Pass
Elizabeth I (92)
Rara I
Mengel I
Jaluit I
Ooa I
Eneeldak I
South Pt
U.S.C.C. Survey
25'
165°30'
35'
4
15'
10'
5'
6°
55'
50'

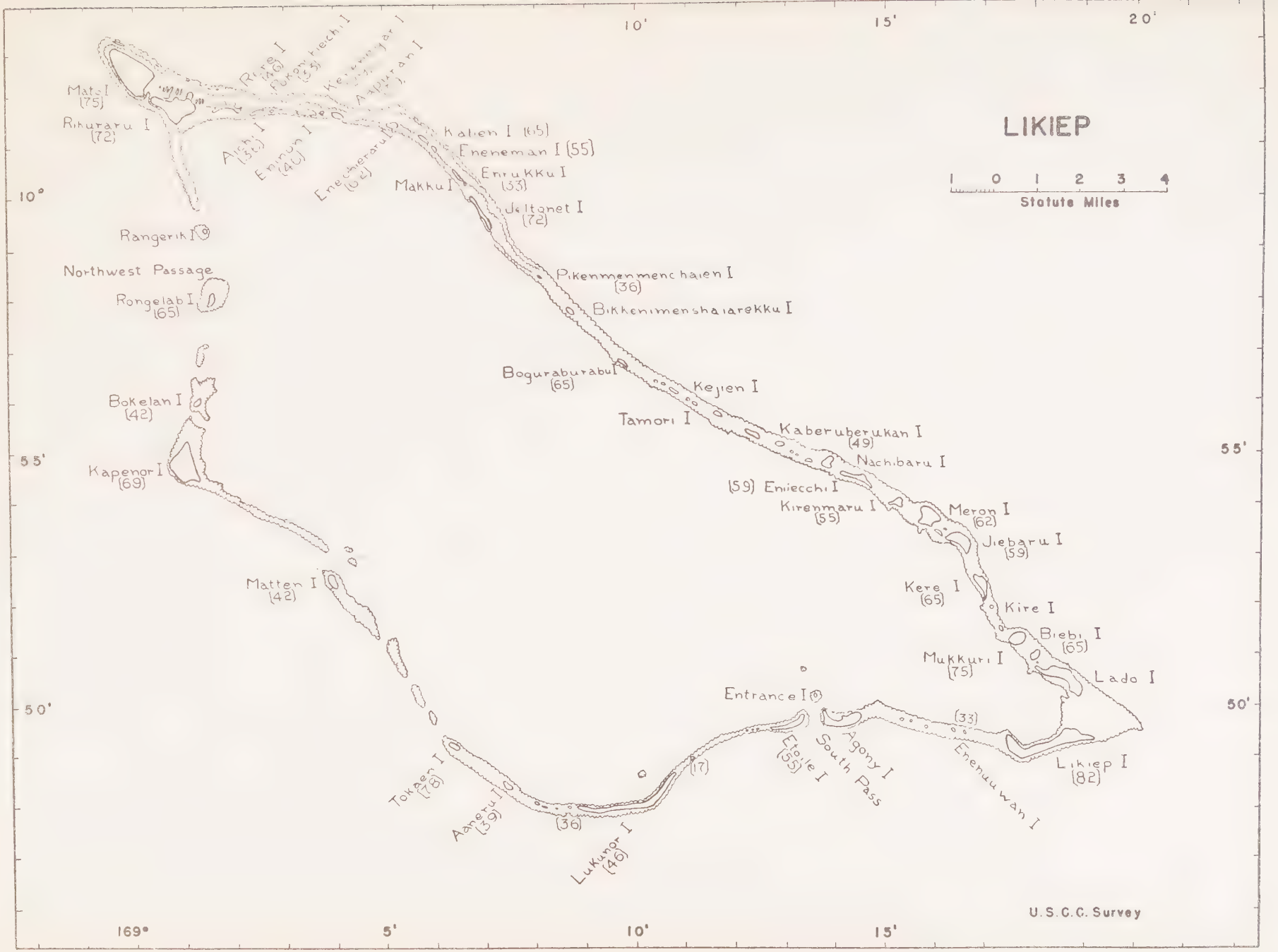
D. JALUIT ATOLL (Population 777 - 1946)
(August 23-24)

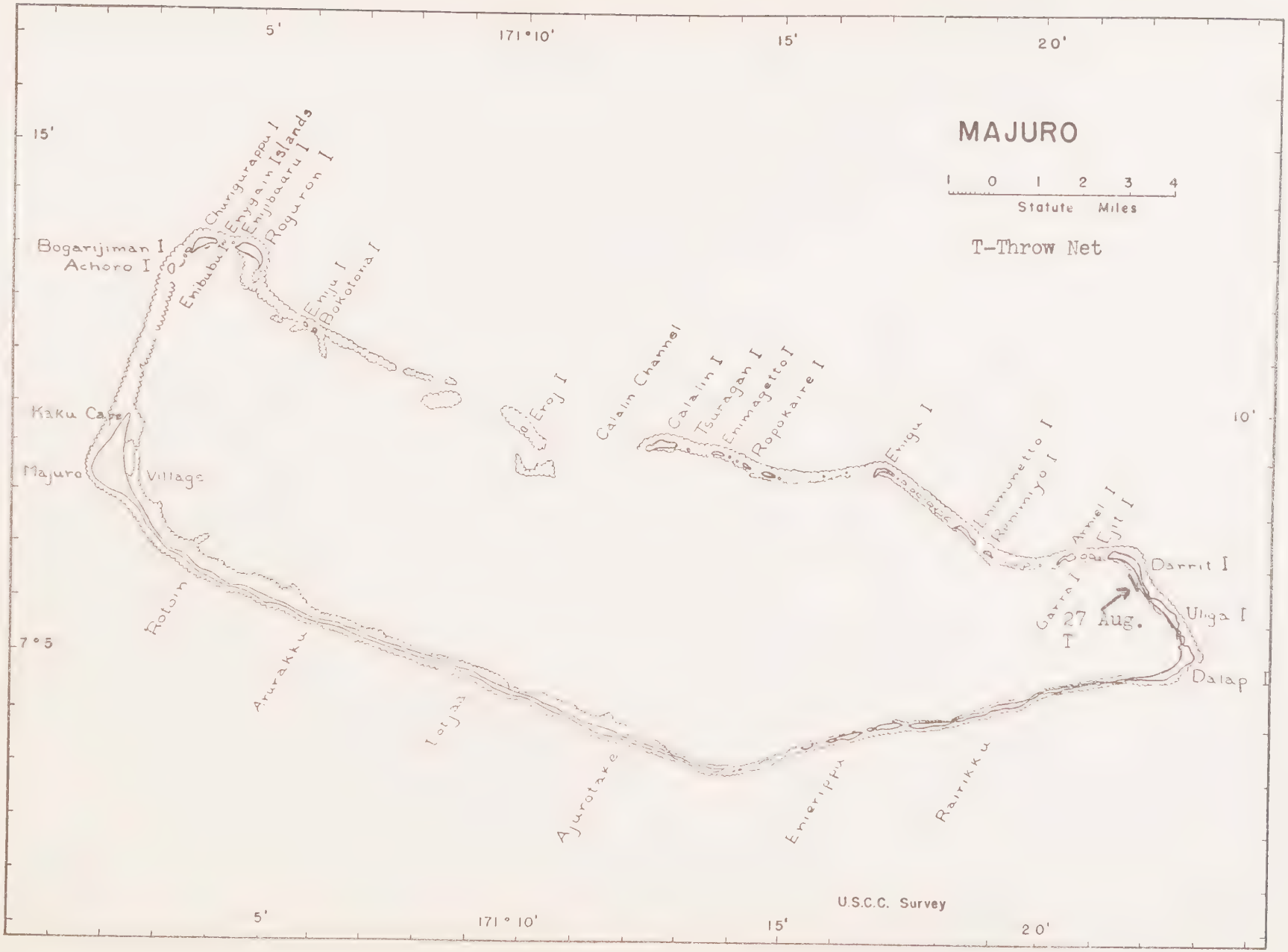
These are flat, sandy islands (Fig. 3), usually narrow and with no barrier reef on the outside. The fringing reef is about 200 feet offshore at high water mark. The seaward beach on Jaluit Island is fairly flat, slightly sloping, and has many small shells such as monkey face and gold ringers. The only sea cucumbers were small black ones (Actinopyga sp.), found ranging in length from two to six inches. On account of the strong surf it was impossible to examine the outer reef. On the lagoon side there was rough coral lava-like reef, extending from shore out approximately 75 feet where the shelf dropped abruptly to five or more fathoms. On the lagoon side mullet and goat fish were abundant, and a number were taken with the throw net. The mullet were approximately eight inches long and the goat-fish from six to nine inches. Other very abundant species were surgeon fish (Hepatus sp.), trigger fish (Balistes and Balistapus) of several species, and a variety of parrot fish (Callyodon sp.), damsel fish (Abudefduf sp.), several species of wrasse (Thalassoma, Coris sp.) and a number of butterfly fish (Chaetodon sp.). Of shell fish, giant clams (Tridacna sp.) up to 12 inches were observed--none larger; the natives stated that large ones were not taken there. Small trochus shells (Trochus niloticus) under three inches were very common, but no large ones were seen. There were also many clusters of small mussels (Brachidontes cerebristriatus)not over one inch in length, on the rocks which were exposed at low tide.

At Imrodj Island the species of fish and shell fish were the same as at Jaluit. An hour was spent trolling from an outboard boat in the northeast pass near Imrodj Island, using a brass spoon and a red and white feather. No strikes were obtained, but many flying fish from 4 to 10 inches in length were seen, and it was apparent that larger fish were feeding on them.

On the lagoon side of Imrodj Island to the northwest is a reef just barely under water at low tide, which has a large population of the giant clam (Tridacna crocea). This species is very abundant and is used by the natives for food. They are collected by hand, by means of a screw driver or a bar of steel to pry the animals out of the coral rock. One fish abundant here, a brown spotted grouper (Serranus sp.), is considered poisonous by the natives, although not deadly so; it is sometimes eaten.

The natives lack almost all kinds of fishing supplies and are especially desirous of obtaining hooks, hand lines, steel rods for making spears, spoons and feather jigs. They formerly had throw nets, but these have been worn out, and they have no twine or lead to knit more. Due to the poor soil, food is not abundant. The main protein is fish, in addition to which the natives have only a few chickens. Fortunately, sea food is very abundant and easily obtained, and with a little assistance in securing fishing supplies the natives should not require much outside help.


LIKIEP
1 0 1 2 3 4
Statute Miles
10'
15'
20'
10°
55'
50'
169°
5'
10'
15'
Mats I (75)
Rikuraru I (72)
Rigei I (46)
Rukonfiechi I (33)
Kejewajar I
Ajpitran I
Aich I (36)
Emmun I (41)
Enecheraru (62)
Kalien I (65)
Eneneman I (55)
Enrukku I (33)
Makku I
Jeltonet I (72)
Rangerik I
Northwest Passage
Rongelab I (65)
Pikenmenmenchaien I (36)
Bikkenimenshaiarekku I
Boguraburabu I (65)
Kejien I
Tamori I
Kaberuberukan I (49)
Nachibaru I
(59) Eniecchi I
Kirenmaru I (55)
Meron I (62)
Jiebaru I (59)
Kere I (65)
Kire I
Biebi I (65)
Mukkuri I (75)
Lado I
Likiep I (82)
Bokelan I (42)
Kapenor I (69)
Matten I (42)
Entrance I
(33)
Agony I
South Pass
Enenuwan I
Etoile I (55)
(17)
Tokaen I (78)
Aaneru I (39)
(36)
Lukunor I (46)
U.S.C.C. Survey


MAJURO
1 0 1 2 3 4
Statute Miles
T-Throw Net
5'
171°10'
15'
20'
10'
7°5
Bogarijiman I
Achoro I
Churigurappu I
Enyyain Islands
Enjibaaru I
Roguron I
Enibabu I
Eniju I
Bukotora I
Eroj I
Calalin Channel
Calalin I
Tsuragan I
Enmagetto I
Ropokaire I
Eniju I
Kaku Cape
Majuro
Village
Rotoin
Arurakku
Ajurotake
Enieripru
Rairikku
Darrit I
Uliga I
Dalap I
27 Aug.
T
U.S.C.G. Survey

A. LIKIEP (Population 614 - 1946)
(August 29)

Because of infections resulting from coral cuts, no collections were made here. According to information obtained from native sources, large giant clams (Tridacna gigas) of three feet and more in diameter are to be found in this lagoon and the Japanese shipped some to Japan, possibly for decorative purposes, but also possibly to be used in button manufacture. The Japanese came to Likiep only to pick up copra and discharge trade goods. There was no Japanese garrison on the island during the war, and the native economy was comparatively unaffected--much less so than in any other place, except for Kayangel Island in the Palaus. No plantings of trochus shell, sponge, or pearl oysters were made here by the Japanese. There are a few trochus shells, but not enough for commercial operation. There are also a few black lip pearl oysters, but not even enough for incorporation into the native handicraft, where it is used as inlay in wood plates and other similar items. There are also a few hawksbill turtles, which are used both for food and in the manufacture of tortoise shell handicraft, particularly fans. However, there are not enough turtles of this type taken to supply the native needs for handicraft, and some hawksbill shells are imported from Ponape. The turtle shells which are taken here are always of small size, rarely over 18 inches in maximum length. There were some large and small smooth black sea cucumbers, but not enough for commercial making of trepang. Some sponges, not planted by the Japanese but natural growing, wash up on the beaches. They are of the type known as horny sponges, stiff and not very flexible or water absorbent. It is not believed that they would have any commercial value, although a sample was brought back. The Japanese did not engage in off-shore fishing. There is an ample supply of all kinds of reef fish to take care of native requirements. The natives also have enough canoes for transportation to and from the fishing grounds. They should have an additional supply of hooks and sinkers for hand line fishing and seine twine for the construction of nets and throw nets.

The Marshallese are excellent seamen and frequently undertake voyages up to 60 miles from their homes, across open water, with loads of provisions, supplies, or handicraft, without navigation instruments of any kind, although a few uncorrected Navy compasses have been obtained recently.

B. MAJURO ATOLL (Population 1236 - 1946)
(August 27-28)

This group of islands if fortunate in nothaving been bombed or strafed and no native supplies or equipment were destroyed by an invasion.

There is no barrier reef on the outside. The fringing reef is from 100 to 150 yards wide, fairly flat, with about a foot of water over it at low tide. On the lagoon side, the beach is sandy with a rough coral ledge of gradual slope running out for 100-200 yards. Fish were abundant on the lagoon side in shallow water and we caught many small mackerel (Scomber japonicus) approximately six inches long and goat-fish (Pseudupeneus) from six to eight inches. It was reported that there are many spiny lobsters (Panulirus) on the fringing reef, which are taken by torching at night when the spiny lobsters come up on the reef at low tide.

As of August 1946 the natives on Majuro Island (Laura) had about 220 sailing canoes and 42 paddling canoes. There is some new construction and the supply of canoes appears to be ample.

Fishing is done by hand line, spears, some trolling, a few seines, and some throw nets. In addition, there is torching at night on the reefs and use of some small woven traps.

Fig. 4... Majuro. Short Spear.
August 1946.

Fig. 5... Jaluit. Sailing Canoe.
August 1946.

Fig. 6... Kusaie.
Trolling (Heavy) and Still-fishing lines.
August 1946.

However, most of the fish are taken by hand lining, using hooks with very short shank. Native needs were principally for fishing lines for hand lining, leader wire, swivels, and enough seine twine to make additional throw nets, of which a few are left, but most have been worn out. They have a few seines of the type known as surround net, but no twine or netting to replace them. Their spears are short, having a wood shaft about four feet long and a point of 3/8 inch round steel rod two feet long, with a plain point, no barb and not very sharp (Fig. 4). They also pound or mash black sea cucumbers to use as a fish poison. This is the only area visited where sea cucumbers were regarded as poisonous, although Thompson (Guam Recorder, May 1941, p. 81) reports that on Guam it was an old practice to use sea cucumbers as fish poison. They are, of course, not eaten by the natives.

Their traps are approximately two by two by four feet and are made of hardwood strips.

The Japanese had no fishing boats located at Majuro, nor did they plant trochus, pearl oysters, or sponges here. However, there does not appear to be any reason why trochus shells could not be introduced on the outside reef.

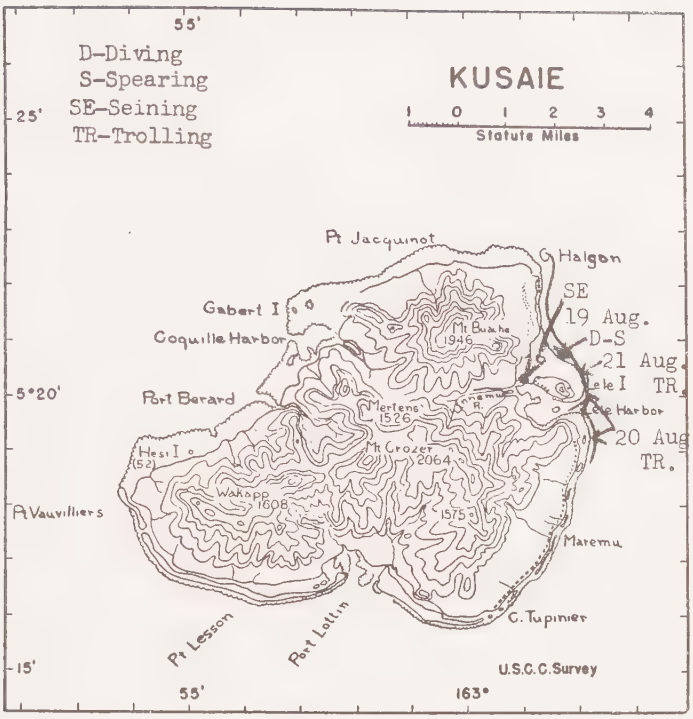
Except for the necessary fishing supplies, as mentioned above, the natives are well provided with means of obtaining fishery products, and it does not seem necessary to make any recommendations for improvements in methods. The Japanese did not find it profitable to locate sampans here for the purpose of catching bonito or other offshore fishes.

The Marshallese sailing outrigger canoes are specially noteworthy and indicated the highest ability in both design and workmanship of any of the island groups visited (Fig.5). These canoes range in length from 20 to 35 feet. One canoe of approximately 35 feet which was examined had a draft of 30 inches, a beam of 24 inches, and was capable of carrying about 15 persons. These canoes have a heavy keel piece, usually of breadfruit, with planking of one inch strakes, 12 to 14 inches wide, and up to 20 feet in length. The strakes are tied to each other and to the keel by hand-woven coconut twine (sennit). The mast supporting the lateen sail may be set at either end of the boat, which, being double ended, makes it possible to sail always with the outrigger on the windward side. These canoes are very fast and will sail within about two points of the wind. The natives do some trolling with these canoes, but depend mostly on spears and throw nets for catching fish.

Fig. 7... Kusaie.
Throw Net.
August 1946.

Fig. 8... Kusaie.
Method of holding
throw-net.
August 1946.

Fig. 9... Kusaie. Paddling Canoe. August 1946.



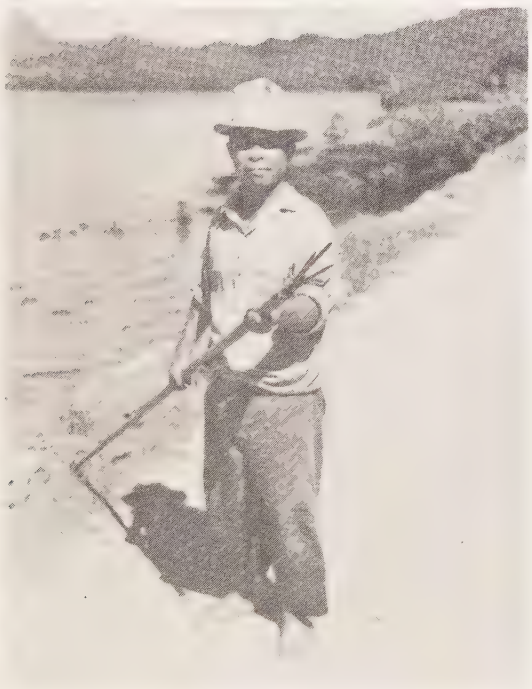


Fig. 10... Kusaie.
4-prong Spear. August 1946.

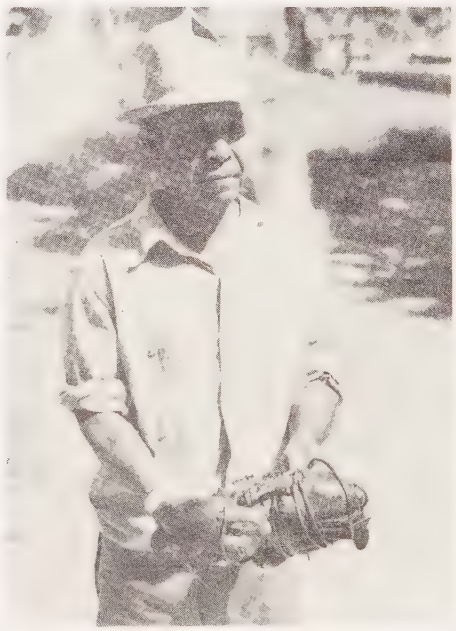


Fig. 11... Kusaie.
Samoan Crab (Scylla serrata).
August 1946.

II. THE CAROLINE ISLANDS

A. KUSAIE ISLAND (Population 1555 - 1946) (August 18-21)

In contrast to the low islands in the Marshall Group, Kusaie is one of the high islands. The native population is about 1,550.

At the present time the reef fishes are somewhat depleted, due to the fact that toward the end of the war the Japanese dynamited extensively inside and outside the reef for the purpose of obtaining food. In view of the depleted population of fishes on the easily accessible reefs, it is necessary for the natives to use as food a good many small size fish from three to six inches, and it seems likely that as long as this is necessary, the recovery of the fish population on the reefs will be delayed. It will probably be two or three years before there is a near normal population of such fish as goat-fish, crevalle, mullet, groupers, and surgeon fish. Even with the dynamiting, however, the abundance of reef fishes is considerably greater than at Truk.

The natives have only paddling canoes (Fig. 9); none is equipped with sail, and the size ranges from 12 to 25 feet. Most canoes are hollowed out from breadfruit logs, but four other kinds are sometimes used. For a 16-foot canoe construction time is approximately three days for six men. The usual method of building is for the prospective owner to get some of his friends to help him, which is also true of Ponape. A number of canoes are being built at the present time and there is no shortage of transportation.

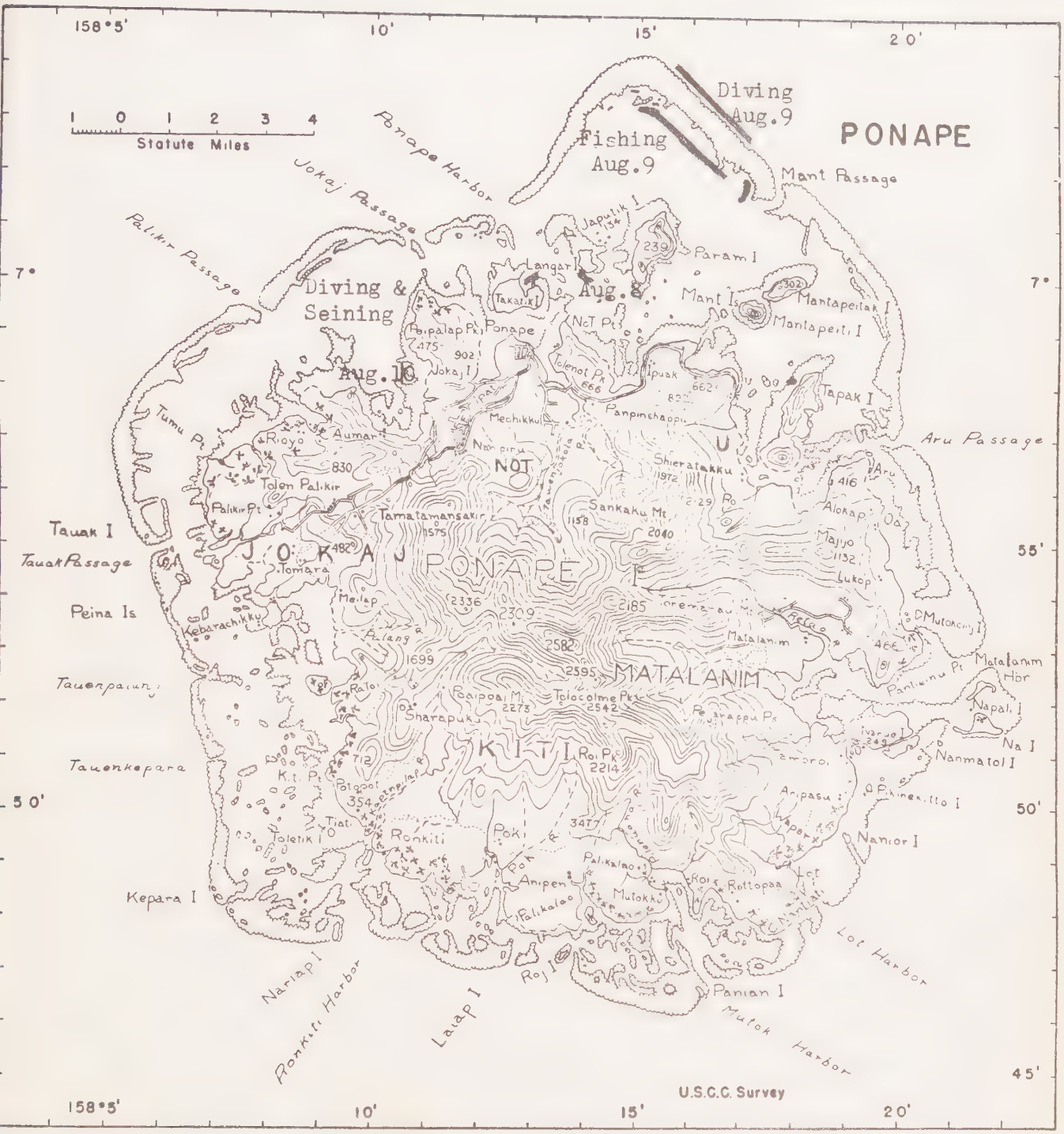
Fishing methods include hook and line (Fig. 6), feather jigs for trolling, spears, throw nets (Figs. 7 and 8), and surround nets. Spears are mostly made with four points (Fig. 10), with a single barb on each, point constructed of quarter inch steel rod about eight inches long and set into a wood handle about six feet long.

The Japanese had a processing plant, including refrigeration, for making bonito sticks, which were exported to Japan. The industry was in the hands of Japanese and Okinawans. No native fishermen were employed. Some trepang was also produced and exported.

The natives catch and use spiny lobsters (Panulirus) (Fig. 27), and Samoan crabs (Scylla serrata) (Fig. 11). Mullets up to twenty inches in length are fairly abundant just off the mangrove swamps, but difficult to catch. There is no commercial trochus, as the Japanese did not plant any here. A small species of no value is present, as well as the rough type of cat-eye (Turba intercostalis), some with fair color.

We explored approximately half a mile of the outside reef about three miles north of the harbor entrance. Fish were not very abundant and half an hour of work for three divers produced only four fish. Five native divers were able to get only two spiny lobsters, approximately 12 inches long in an hour of diving. Such fish as are present are very wild and immediately go to deep water when any divers get near them. There is no barrier reef at Kusaie, the fringing reef being only from a few yards to a quarter of a mile off the beach, which is generally sandy. The slope is gradual from the reef out, the depth of water approximately 400 yards off the reef being only two to two and a half fathoms.

In view of the scarcity and wildness of fish, most of the natives carry bundles of Derris elliptica roots in their canoes to use as fish poison. The roots are pulverized in the bottom of the boat and than dumped over in partially closed areas, where they bring up many small fish. As far as we were able to find, Barringtonia (Barringtonia asiatica) nuts are not used, although the natives were familiar with them.


158°5'
10'
15'
20'
7°
55'
50'
45'
1 0 1 2 3 4
Statute Miles
PONAPE
Diving Aug.9
Fishing Aug.9
Diving & Seining Aug.10
Aug.8
Ponape Harbor
Jokaj Passage
Palikir Passage
Mant Passage
Aru Passage
Tauak I
Tauak Passage
Peina Is
Tauenpaiung
Tauenkepara
Kepara I
Nariap I
Ronkiti Harbor
Laiap I
Roj I
Panian I
Mutok Harbor
Lot Harbor
Nanmatol I
Na I
Napali I
Matalanim Hbr
Mutokeniu I
Param I
Mant Is
Tapak I
Japuluk I
Takai I
Ponape
Jokaj I
Mechikku
Panpinchappu
Shieratakku
Sankaku Mt.
Tamatamansakir
Tomara
Melap
Palang
Sharapuk
Paaipoai Mt.
Tolocolme Pk.
Matalanim
Kreman Mt.
Majyo
Lukop
Alokap
Aru
Pankienu Pt
Ronkiti
Pok
Anipen
Palikalao
Mutokk
Rottopaa
Anipasu
Nanior I
Kepara I
U.S.C.G. Survey

It was reported to use that a sword fish (probably marlin), weighing approximately 240 pounds, was taken by still fishing on a hand line the week before. The dead bait used for this was a whole fish, weighing about two pounds. The fish was caught in approximately eight fathoms.

The natives are very short of hooks and lines, as they have had no communication with any sources of supply since February, 1946. They no longer make their hooks or lines according to their traditional customs and are completely dependent on manufactured supplies for their fishing. During our stay at Kusaie, we had a native fishing crew set a beach seine, and from a haul--which it took them about an hour and a half to make--they caught only a few small striped surgeon fish, approximately eight inches long. Their net originally surrounded several dozen large mullet, but all jumped out. We also spent several hours trolling outside the reef and found barracuda very abundant. Of those caught, the largest was 53 inches long and weighed 22 pounds. We also lost tackle twice on fish so large, that they broke the line. During our trolling we continually had overboard both a polished brass spoon (size #7) and a white Japanese feather type jig, which were operating side by side. We found here, as everywhere else, that more strikes were obtained on the spoon than on the feather.

Since the natives do not have sailing canoes, nor any powered motor vessels, they are at a disadvantage in attempting to troll. The native fishermen at Kusaie are very intelligent and progressive and would very much like to obtain small powered fishing boats, around 30 to 40 feet in length, with small diesel engines similar to the Japanese semi-diesel which power all Japanese sampans. These would be suitable for trolling, and it is believed that a considerable quantity of fish could be taken by the natives without outside assistance--except that there are at present no refrigeration facilities at Kusaie, and excess catch over and above what could be consumed by the population within twenty-four hours could not be preserved. Methods of salting could be developed in lieu of refrigeration, but storage would still be a problem. Salt of the proper kind would have to be shipped in.

B. PONAPE ISLAND (Population 5662-1946)
(August 8-13)

Ponape was the third most important Japanese fishing center with shore facilities, including refrigeration. All of these have been completely destroyed. At the present time there are two Japanese sampans, 35 to 40 feet long, still in operation. These are powered with the Japanese single cylinder, semi-diesel engine which must be started with a blow torch.

Being a high island, Ponape has an ample supply of hardwood trees for the construction of canoes and there does not appear to be a great shortage of these craft at the present time. A number of new ones are being built. The cost of a 12-foot canoe is around $12.00.

The chief methods of fishing used by the natives are: spears, hand lines, nets, small hand nets used by women, and the hand picking of small shell fish along the reefs.

Sea cucumbers are abundant around Ponape and a small sample was processed into trepang to determine whether or not it was of the quality desired for export to China and Japan.

The Japanese had introduced trochus shells along the outer reefs and these are now abundant, as they were notharvested during the war years. About 10,000 had been brought in to U. S. Commercial Company headquarters for sale by various natives and most of them were over five inches in diameter at the base. These are mostly old shells and many of them were badly corroded. Approximately 50 percent of the shells brought in were rejected by U. S. C. C. It is believed that before these shells are finally rejected and disposed of samples should be forwarded to United States and Japanese shell dealers to determine whether

or not they have any commercial value. It is bad from a conservation standpoint, and discouraging to native fishermen, to discard so large a percentage of the trochus taken.

The black lip, or pearl oyster (Pinctada), is common in water from one to four fathoms deep, in the area between the fringing shore reef and the outer barrier reef. At the present time no use is being made of these shells. As the total quantity is not large, it is doubtful if it would pay to put them on the world market. They could, however, go into inter-island trade to be used as inlay in native handicrafts.

Cowrie shells (Cypraea tigris) are very abundant, particularly around Matalanim, and many hundreds are brought in by the natives for sale. The present price to the natives is three for ten cents. A large number of these shells are now being rejected because of a milky appearance of the shell, which is the result of improper drying. In order to retain the high natural polish they should be either buried in dry sand for a month or six weeks, or the animal inside them can be rotted out in sea water and then the shells dried in the shade. Usually the milky appearance which renders them unsuitable for trade purposes results from exposure to the sun and to fresh water.

Small giant clams (Tridacna) up to 12 inches are very common and are eaten in large quantity by the natives. As far as we were able to determine, there are no very large ones ranging up to three feet or more.

The barrier reef here is notable in being very wide, up to 150 yards, and also peculiar in dropping off abruptly on the lagoon side to four or five fathoms. Along this inside edge large parrot fish (Callyodon sp.) and crevalles (Caranx sp.) of 10 to 15 pounds weight are very common, but wild and difficult to catch as they immediately seek deep water when fishermen come around. Small mullet, up to 10 inches in length, are common in the shallow water on top of the reef. Also abundant are several species of goat-fish (Pseudupeneus) around eight inches in length and occasional schools of large blue wrasse (Cheilinus sp.) weighing up to 30 pounds. As many as 17 of the latter have been taken in one haul of a homemade beach seine. This type of seine is set in a semicircle on a flat part of the barrier reef and then a number of fishermen splash and drive fish into the center pocket. Due to the roughness of the bottom, it is not possible to haul the seine as is done with most beach seines.

Along the outer edge of the barrier reef there are many rough cat-eye (Turbo) shells, some of which contain cat-eyes of fair quality. We did not see any of the smooth type, which are the most valuable.

The natives of Ponape do not use either stone fence traps or large traps of any kind. There are several bamboo fence traps which had been constructed by natives from Yap. We were unable to obtain any information as to the production obtained from these traps.

Hawksbill turtles are fairly common around Ponape and a number are taken annually. The price set by Military Government is 80 cents a kilogram for thin shell and $1.30 per kilogram for thick shell. The Japanese paid from ¥100.00 to ¥160.00 per kilogram. In computing the price, the whole shell is weighed. A large shell weighed approximately six kilograms. Turtles are taken mainly by spearing or are caught by hand, but a few are also taken by nets.

Under the Japanese the natives obtained some income from the preparation of trepang from sea cucumbers. The Japanese paid 30 sen (¥.30) per kilogram for fair quality, 45 sen (¥.45) per kilogram for good quality and 75 sen (¥.75) per kilogram for very good quality. The abundance of sea cucumbers warrants a resumption of this business, if markets can be found.

In general, the catch made with seines was very small and scarcely paid for the labor involved. For example, one set of the net brought the seven men who fished it

only four black surgeon fish, approximately seven inches long, and one large-eyed red squirrel fish (Myripristis sp.) eight inches long, although the time required to send the net was an hour and a half. In two hours of diving along the fringing reef inshore three divers obtained five black-lipped oysters of a diameter of six inches. One of them contained a tiny baroque pearl of no value. We also found large pinna shells of genus Atrina quite common. The adductor muscle is large and similar to that of the ocean scallop. However, it is not eaten by the natives although it has a very good flavor. One of these Atrina shells had six tiny black pearls, approximately 1/64 inch in diameter. We also found a number of sponges, which are native to the area and are used by the local population in place of towels after bathing. These sponges are of cylindrical shape, with a large central cavity. The outer walls are from 3/8 to 1/2 inch thick, with sections branching from the main stem approximately 12 to 14 inches in length. A sample of this sponge was brought back to determine whether or not it might have a commercial value. Since these sponges seem to grow very well, there should be no reason why the culture of more desirable species could not be undertaken.

Every native canoe carries several bunches of derris roots (Derris elliptica) to be used in poisoning fish. The natives pound the roots to a pulpy mass and then throw the whole thing into holes and caverns on the inside edge of the reef. This is a wasteful kind of fishing, as even very small fish are narcotized and are destroyed without being of any use, although at the present time the natives keep even small fish three to four inches long. While on the subject of poisons, it may be said that barringtonia (Barringtonia racemosa and asiatica) occurs at Ponape, but is not commonly used by the natives as a fish poison, although its use is known. Tephrosia (Tephrosia purpurea) also occurs here and its use as a fish poison is known to the natives, but they do not use it as they say it gives the fish a bad flavor.

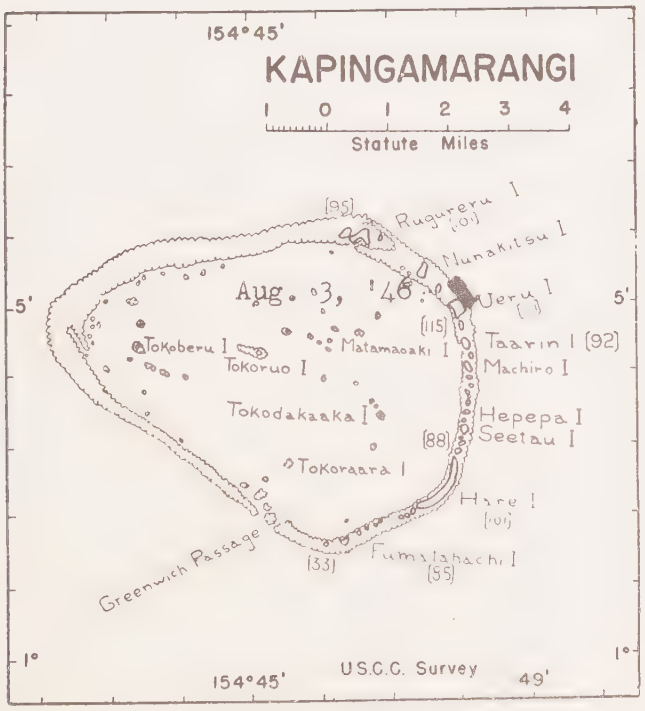
It was surprising to find no native jigs made of pearl shell body with tortoise shell barbless point such as were common at Kapingamarangi and Nukuoro. It was stated that the Ponapeans did not make these and did no trolling until steel hooks were introduced by traders. The bonito fishing was carried on exclusively by Japanese and Okinawans. Even at present the outside trolling is done chiefly by natives from Yap using sailing canoes, or occasionally by paddling. The total catch by trolling is inconsequential, each boat getting only one or two fish per day. There is no processing of the catch, all being consumed fresh. The bonito (Katsuwonus pelamis) in this area run to about 15 pounds each.

With the exception of one native who, with his family, fishes for trochus and other shells, trepang, and turtles, there are very few of what might be called professional fishermen around Ponape. Almost all of the natives have canoes and fish for subsistence only, but much of their time is devoted to agriculture.

At the present time the fishing lines are mostly of sennit, woven by the men by rolling fibres of ripe coconut husks on their thighs. Hand net and seine twine is also made from this and ranges in size from approximately #15 to #40. The locally made spears either have a single simple barb on the end, made of quarter-inch steel rods two feet long, or may have three or four barbless points of 1/8 or 3/16 inch round rod. In either case the points are set into a wood shaft 5/8 inch in diameter and six to eight feet long.

The area in the vicinity of Ponape town is similar to Truk in that the Japanese were short of protein food towards the end and did much dynamiting of fish, mostly inside the outer reef and along the outside of the inner fringing reef. The fish population is therefore somewhat reduced, especially the smaller reef fishes. The larger fish, including the blue parrot fish (Callyodon sp.), crevalle (Caranx sp.), and mullet (Mugil cephalus), are very wild. The mullet here range in size up to 18 inches in length and two and a half pounds in weight. Shell fish of all kinds were also taken by the Japanese in large quantities as food. Even the black-lipped pearl oysters (Pinctada sp.), trochus (Trochus niloticus), and cat-eyes (Turbo sp.), as well as Cardium and Anadara, were eaten and are

155°
NUKUORO
55
1 0 1 2 3 4
Statute Miles
Stone
Fishtraps
Aug. 8
'46
3°50'
1 Tonga Keri Keri I
2 Kapinivere I
3 Namuirotoa I
4 Motonui I
5 Aru Kanui I
6 Tahangatabu I
7 Tahangaroro I
8 Motu Iiwo I
9 Sapinimatok I
10 Motu Wei I
11 Ahuroroa I
12 Tuila I
13 Shugnaurohu I
14 Takonran I
15 Nukuoro I
16 Shenukdai I
17 Kaujeme I
18 Motu Iloto I
19 Deanna I
20 Oromange I
21 Nukuoro Passage
U.S.C.C. Survey
155°


154°45'
KAPINGAMARANGI
1 0 1 2 3 4
Statute Miles
5'
Aug. 3, '46
(95)
Rugureru I
(101)
Nunakitsu I
Jeru I
(115)
Taarin I (92)
Machiro I
Tokeberu I
Tokoruo I
Matamaoaki I
Tokodakaaka I
Hepepa I
Seetau I
(88)
Tokoraara I
Hare I
(101)
Greenwich Passage
(33)
Fumutahachi I
(55)
1°
154°45'
U.S.C.C. Survey
49'

now much more scarce than formerly. We found no large trochus shells, even on the outer reef. According to our information, the area around Kiti and Matalanim was not greatly affected by the Japanese occupation and the supply of fish and shell fish was not greatly reduced there. This was due to the fact that the Japanese moved away from Kiti when the American bombing of the island started.

A few native nets are constructed entirely of local materials. One was four fathoms deep and 38 fathoms long. The mesh or bar is 2-3/4 inches square, made from sennit twine, about #60 size. Floats were made of hibiscus wood (kalau), 2-1/2 inches in diameter by 16 inches long, spaced 17 inches on the cork line. Leads are of Anadara shells, also spaced 17 inches apart. The net is used mainly for catching large blue parrot fish inside the outer reef.

The natives make a wide variety of handicraft articles from tortoise shell. For sale at the U.S.C.C. store were combs, belt buckles, wrist watch straps, and rings. The rings have silver or brass inlay. In general, these tortoise shell products were of very poor quality. The shell was not selected, in the first place, for attractive markings, nor was it well finished. Combs sell for 85 cents and a dollar and many have little other than curio value. The wrist watch bands sell for 75 cents and unfortunately do not fit all watches. The rings sell for a dollar. Proper design and finishing would greatly increase the attractivness and saleability of these articles. It was reported that the only material available to the natives for polishing tortoise shell articles is old Japanese tooth paste, which apparently is much coarser than ours. No machinery is available for cutting, grinding, orpolishing.

At the time of this survey the natives had no supply of the larger or smaller sizes of fish hooks; only a comparatively small stock of medium size hooks being on hand. There was no fish line at all, nor seine twine for making throw nets. Most of the throw nets which the natives had are now worn out.

Note on Fishing Vessels

The harbor at Ponape is littered with the hulls of Japanese sampans, ranging in size from 25 to 50 feet. All of these hulls, both in and out of the water, are beyond salvage. Two sampans about 45 feet long are now being operated by Military Government. One, which is assigned to a native sub-chief, is approximately 36 feet long and in very poor condition. Water transportation around Ponape is dependent on these three Japanese boats, although there is a limited amount of travel by native canoe. The Japanese boats are powered with one to three cylinder, two cycle, direct reversing, semi-diesel engine which is started with a blow torch and develops approximately 15 horsepower per cylinder at 600 R.P.M. This type of engine uses a very heavy diesel fuel and will not operate on American fuel of 50 cetane. The engine is of the straight drive type without reduction gear and has a simple clutch with throw-out or neutral, but no reverse. The propeller is about 24 inches in diameter, with a 20 inch pitch, and the usual speed is six to eight knots. The vibration is terrific.

C. NUKUORO ATOLL (Population 235 - 1946)
(August 6)

There is no barrier reef, the fringing reef extending from shore out approximately 150 yards. The edge of the reef drops abruptly to over six fathoms. There is about six to 12 inches of water over this reef at low tide. The reef, although flat, is extremely rough, having many scattered rocks up to three feet in diameter over it. Small shells used in handicraft, such as the so-called "monkey-face" and "gold ringers", are abundant. These are to be found under the rocks in approximately six inches of water. Small black sea cucumbers, six to eight inches long, were extremely abundant on this reef. We saw no yellow ones. It was reported that the spiny lobster (Panulirus) is very abundant on this

reef and we noted that the natives had a special instrument which consisted of a small sharp-pointed steel hook fastened in the end of a stick approximately 12 inches long which was used for jerking lobsters out of their holes in the rocks. They also make an unusual type of spear which consists of a light steel rod approximately 1/8 inch in diameter and three feet long, which is shot by means of a sling. The sling consists of two pieces of tire tube which are slipped over the thumb and forefinger of the left hand and the sling is used as boys use a slingshot.

Fish were very abundant along the outer edge of the reef in from one to two fathoms and were comparatively tame. Among the more abundant species were crevalle, goat fish, parrot fish and wrasse.

There are a few throw nets knit locally from twine previously furnished by the Military Government. The last supply of this was received in February 1946 and the number of throw nets available to the natives is still inadequate. Also there are several beach seines made of coconut fiber, which have a square mesh of approximately an inch and a quarter. The twine is very coarse and about the size of #40 cotton twine. They have some #40 twine which they use for trolling for skip jack, bonito, and albacore. Usually two or three fishermen go out together and one paddles or handles the sail while the others tend the lines. For bait they use a homemade jig, the body of which is cut from black-lipped pearl oyster shell, which is common. Ordinarily they use an American type steel hook, although if these are not available they make a barbless hook out of tortoise shell and tie it onto the pearl shell body. A strip of fish is put on the hook for bait. We saw several fishing canoes with one or two bonito, weighing from 15 to 25 pounds, which were caught with this type of gear. One native said they formerly used bamboo poles and fished in very much the same manner as the Japanese do and that four men sometimes brought in a hundred fish in a couple of hours. At the present time there is no bamboo left on the island for poles. It is not grown locally and should be furnished.

A few hawksbill turtles are taken, from which the tortoise shell is obtained for use in handicraft--most of it to make the centers of fans.

The natives here are very good fishermen and need little help other than to be furnished with such necessary supplies as fish hooks, bamboo poles, cotton seine twine ranging in size from #20 to #60, some bulk lead to be used in making leads on nets, and a few feather jigs and spoons to supplement their homemade articles. From the abundance of bonito seen here it is possible to assume that the natives could establish a small drying plant for the production of bonito sticks.

D. KAPINGAMARANGI ATOLL (Population 441 - 1946)
(August 3-5)

There is no barrier reef, the fringing reef being in most cases only a few yards from shore. The area from the reef to shore is of flat rock, comparatively smooth and with approximately six inches of water over it at low tide. Except for an occasional small white branching coral three or four inches high, the entire surface of the reef could be used for seining and is very well suited to throw-netting. An examination was made of this reef at night, at which time many large yellow sea cucumbers, from eight to fourteen inches long, and a few small black ones, four to six inches long, were observed. The quantity found, if present throughout the reef, is sufficient for limited production of trepang. The outer edge of the reef drops off sbruptly just beyond the surf. In this case the surf was too heavy for us to examine the fish population on the outside edge of the reef. On the occasion of our visit spiny lobsters (Panulirus sp.) were rare, only one being seen, although the natives report that many of them are found at times. We also saw quite a few surgeon fish (Hepatus sp.) mostly under six inches long. The fact that this section of the reef is opposite the native village of Souwou probably accounts for the small number of fish observed.

Figure 12...
Kapingamarangi.
Canoe houses, lagoon side.
August 1946.

Figure 13...
Nukuoro
Paddling Canoe.
August 1946.

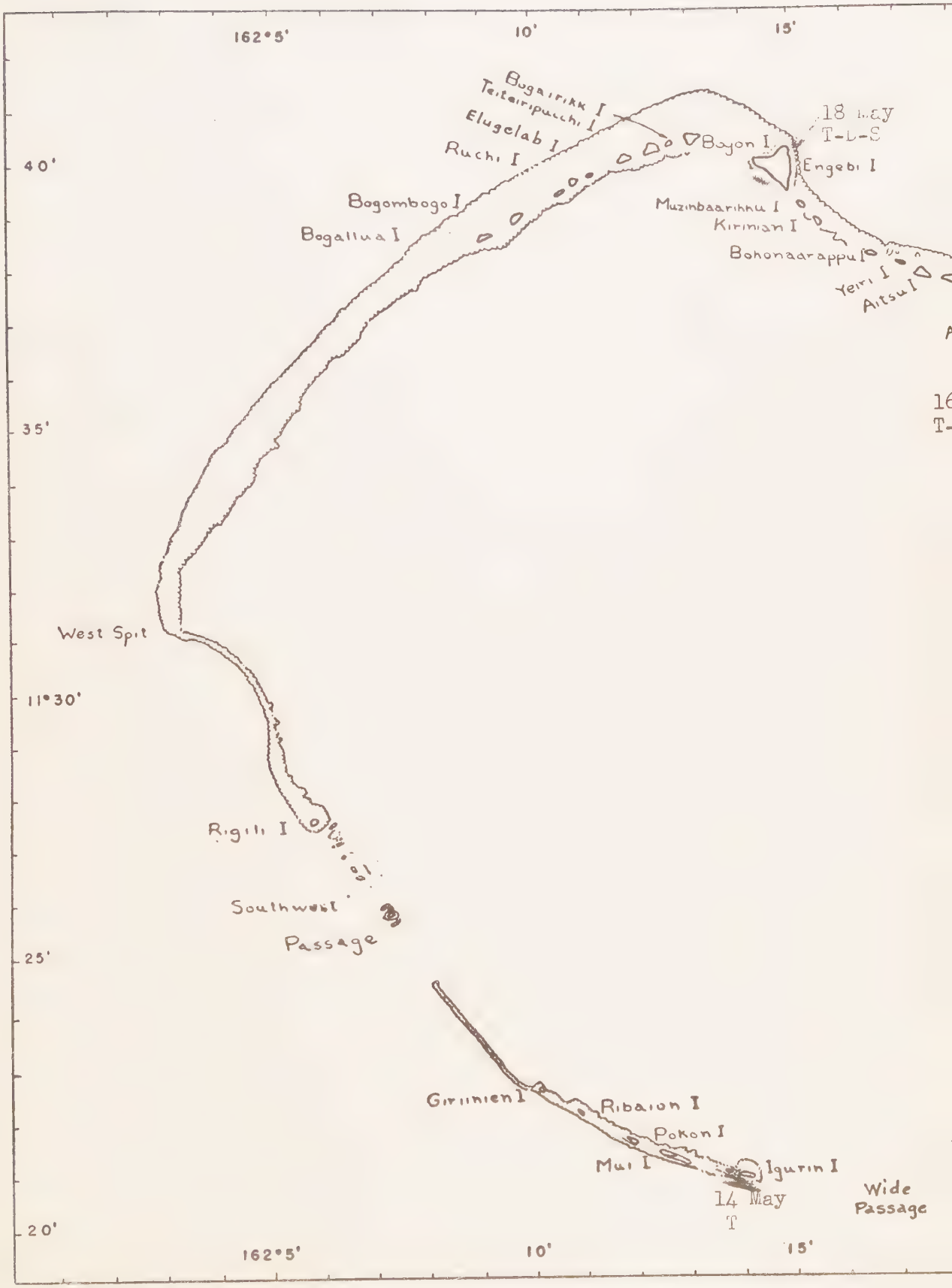
Figure 14...
Kapingamarangi.
Fish Spear.
August 1946.

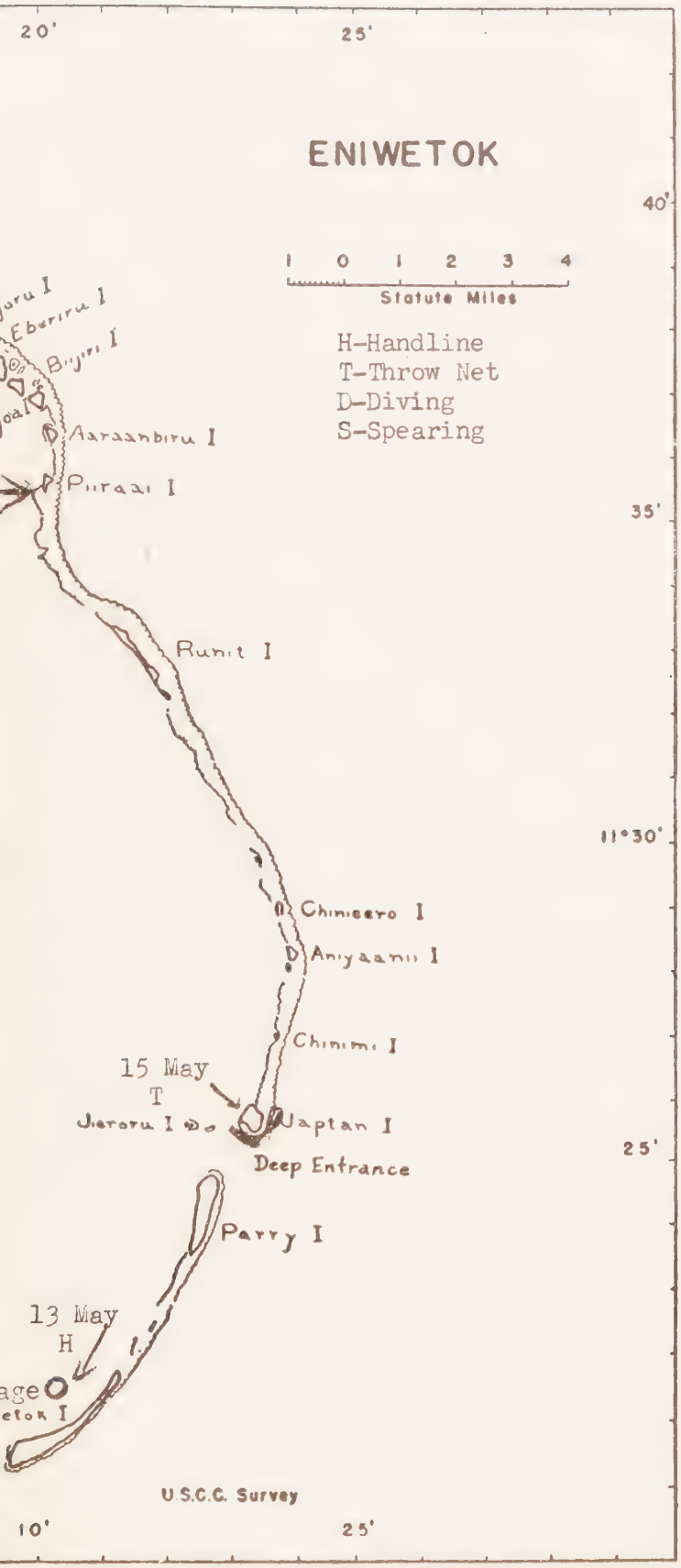
Figure 15... Kapingamarangi. Stone Fish Trap. Low tide. August 1946.

Figure 16... Kapingamarangi. Sailing Canoes. August 1946.

Figure 17... Kapingamarangi. Paddling canoe and scoop net for Flying Fish. August 1946.

Figure 18... Kapingamarangi. Detail of fish traps. August 1946.


162°5'
10'
15'
40'
35'
11°30'
25'
20'
Bogairikk I
Teitairipucchi I
Elugelab I
Ruchi I
Bogombogo I
Bogallua I
Bogon I
Engebi I
Muzinbaarikku I
Kirimian I
Bohonaarappu I
Yeiri I
Aitsu I
18 May
T-L-S
16
T-
West Spit
Rigili I
Southwest
Passage
Giriinien I
Ribaion I
Pokon I
Mui I
Igurin I
14 May
T
Wide
Passage


20'
25'
ENIWETOK
40'
1 0 1 2 3 4
Statute Miles
H-Handline
T-Throw Net
D-Diving
S-Spearing
Eberiru I
Aaraanbiru I
Puraai I
35'
Runit I
11°30'
Chimeero I
Aniyaanii I
Chinimi I
15 May
T
Jororu I
Japtan I
Deep Entrance
25'
Parry I
13 May
H
U.S.C.G. Survey
10'
25'

TRUK
Statute Miles
D-Diving
S-Spearing
T-Throw Netting
Good fishing grounds
Bonito, Crevalle, etc.
June 3
D-S-T
Trolling
Both
Ways
May 24
Trolled
both
ways
Trochus
along
this
reef
Trolled to
Fala-Beguets
and
back, 29 May
Trolled May 23
Trolled to Udot
and back, May 28
Trochus
Trochus
Trochus
Trochus
Trochus
Trochus
Trolled
Northeast Passage
Northeast Islands
Northeast Pass
Sand I.
MOEN I
PATA
TOL I
POLLE
FALA-BEGUETS I
UDOT I
DUBLON I
FEFAN I
UMAN I
Eot I
Eloi I
Param I
Tarik I
Eten I
Fanamu I
Onna I
Boquet I
Eli Kanibu I
Small I
Bush I
Herit I
Yanagi I
White Sand I
Ulalu I
Kuli I
Fatessicz I
Aga I
Scheiben I
Fala I
Osakura I
Fanuela I
Buet I
Fanuet I
Fanamar I
Falas I
Yawata I
Taualap Pass
Allei Reef
Faleallej Pass
Lelom Reef
Lelom Pass
Fanuran Reef
Piaanu Pass
Onamue I
Allanseru I
Ulperu I
Sobu Reef
Fanurmot I
Tonuamu I
Tsis I
Take I
Atkin I
Faleat I
Fananan I
Onnaram I
Merryberyb I
Pisinmeli Komo I
Pisar I
Faluaw I
Alanemo I
Lball I
Quoi I
Basis I
Mor I
Tonelik I
Onaol
Ushi I
Lapie
Tora I
Holap I
Alanenkobwe I
Lamoil I
Falalul
Pis 1
Eberuru Pass
Tural Pass
(Urashima Pass)
U Island
Northeast Islands
[69]
[52]
[39]
[6]
[4]
[36]
[65]
[46]
[62]
[55]
[203]
[88]
[249]
[92]
[24]
[154]
[236]
[20]
[5]
[10]
[2]
[1]
[8]
[7]
[6]
[5]
40'
35'
7°30'
25'
20'
30'
35'
45'
50'
55'
152°

While examining this reef at 9:30 p.m. we saw six natives in a canoe catching flying fish (Cypselurus simus) in their traditional manner. Four of the natives paddled the canoe, while two men with long-handled scoop nets (Fig. 17) stood up in the canoe and caught the fish which were attracted by a torch made of dried coconut leaves. The natives paddled the canoe up and down along the outer edge of the reef, possibly 50 to 100 feet outside the surf. The torch was kept burning brightly and attracted the fish. The two men with the nets got them as they went by. The nets are 30 inches in diameter and the bag is four feet long and mounted on a frame so that the bag does not collapse. The handles are eight feet long. The flying fish were eight to ten inches in length.

On a sand reef exposed at low tide we saw two fish traps of coral rock made by the natives (Fig. 15). They are V-shape, with the point near shore and the opening away from shore. The sides of the V are 50 yards long. Fish entering the traps were bottled up at high tide by means of netting stretched across the opening of the V, and as the tide receded were chased to the foot of the V where they were taken at low tide.

There seemed to be no shortage of canoes. These are made locally from breadfruit logs hollowed out with an adze. The usual length is from 14 to 30 feet. Every family had at least one canoe (Fig. 16); some had more than one. As was the case elsewhere, the prospective owner of a canoe obtains the log and enlists the services of several of his friends to help with the construction. On Kapingamarangi the owner furnishes his helpers free lunch, but no money, as each man is repaid for service as needed. Most of the canoes 20 feet or longer carry a sail.

The chief methods of fishing include spears, throw nets, seines, traps as described above, and also small basket traps made of bamboo, which are roughly 18 inches square by 30 inches long. (See Fig. 18).

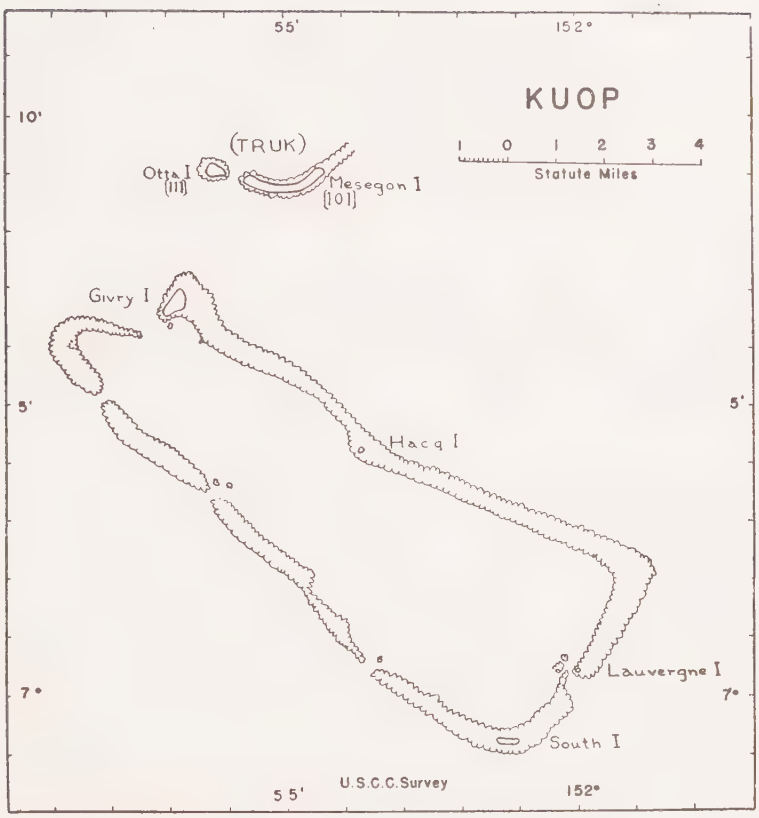
On the lagoon side of the island there are many individual coral heads sticking up from the bottom in from one to three fathoms of water. These coral heads frequently come within three feet of the surface. Around them there is an abundance of reef fishes and the natives say there has been no shortage.

Due to the isolated location of this island it is not regularly visited by trading ships and arrangements should be made to supply the natives with fish hooks, hand lines, seine twine for making nets and throw nets, and some steel rods, approximately 3/8 inches in diameter, for making spears.

To prevent depreciation from either checking in the sun or attack by marine worms, canoes are stored in sheds when not in use (Fig. 12). This practice is common throughout Micronesia.

E. TRUK ISLANDS (Population 9750 - 1946)
(May 23 - June 3)

From the fishery standpoint, the most striking feature of these islands is the general scarcity of fish. Toward the end of the war Japanese garrisons totaling as many as 40,000 men were isolated from home supplies and depended largely on sea food for meat. Since they were prevented by our bombing from using fishing vessels, it was obtained mostly by dynamiting. This was carried on so continuously and over such a wide area that there is at the present time a very great scarcity of fish of all kinds on the reefs and inside the lagoons. Since the native population is very short on protein, they have been forced to use very small fish and shell fish and it is expected that it will be from three to five years before the normal supply of fish is again present in the area. If other protein foods could be supplied, it would be desirable to restrict the taking of all immature fish, but under present circumstances it is not believed possible without great hardship to the native



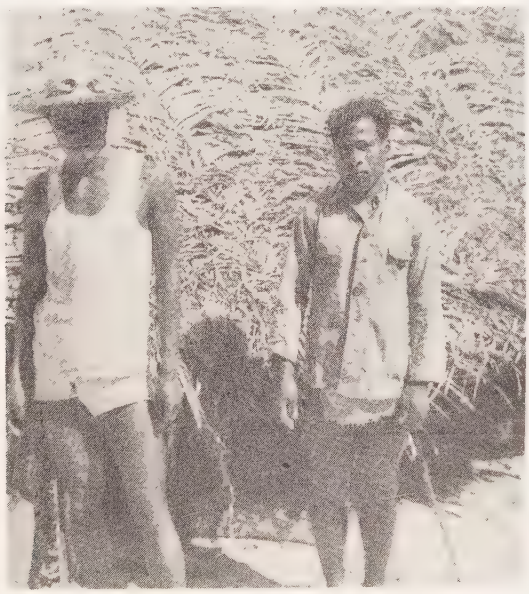


Fig. 19... Truk. Short Fish Spear. May 1946.

population. Using both hand lines and trolling, the only fish we were able to take in any quantity at all were remoras. Altogether we trolled both feather and spoon for 18-1/2 hours inside the lagoon and caught only one fish, a snapper (Aprion virescens) 18 inches long.

At Falas Island, the reefs were searched for fish and shellfish. Fish were very rare, only a few small striped surgeon fish and goat-fish under five inches were seen. None of these fish was in sufficient quantity to use a throw net. On the seaward side of this island there were many "gold ringer" shells under rocks in depths from three inches to two feet. "Monkey face" shells (Cypraea moneta) were also quite common, and there were some small tiger cowries, (Cypraea tigris) around two inches in length. Black sea-cucumbers, both smooth and rough types, were very common, but no yellow ones were seen. Outside the reef on the seaward side there were a few small crevalle (Caranx sp.) 12 to 14 inches long, but very wild. We were unable to get close enough for spearing. Small sand sharks, two to four feet long, were quite common.

On May 28 an examination was made of the outside reefs at Udot Island. The beach is sandy and slopes off very gradually approximately a hundred yards to the fringing reef. The depth over the flat area is approximately a foot at low tide. On this flat are many black sea cucumbers and under the rocks there are many small decorative shells, such as the monkey face and gold ringers used in handicraft. There were a few scattered schools of mullet, approximately eight inches long. Six were caught with one cast of the throw net. In general, however, all of the small fish here were very wild and difficult to approach. The fish caught were given to the natives, who took even the small finger mullet, two to three inches long. The chief on this island said that they have had no fish to speak of since the Japanese dynamited along the reefs near shore both day and night. A few trochus under three inches were also seen, but as we did not examine the outer face of the fringing reef, no large ones were found. A number of small blue parrot fish about six inches in length were seen, but could not be approached closely. We also saw several barracuda (Sphyraena sp.) 10 to 12 inches in length.

Outrigger canoes were very scarce and we were told that there were no breadfruit trees on the island large enough to make canoes. The Japanese had destroyed most of the canoes throughout the Truk group in order to prevent the natives from communicating with United States vessels.

We also trolled on the seaward side of Udot Island, looking for schools of bonito, but saw none, nor were there any flocks of birds hovering over the water as is the case when schools of fish are feeding. We trolled both a feather jig and a brass spoon for an hour and a half without obtaining any strikes.

The natives need many types of fishing implements, especially throw nets. Only a few are now available, as most of the nets they had under the Japanese have worn out and there is no twine from which to make new ones. Most of the fishing is done by women on the shallow reefs, using the small hand nets called epino with which they catch very small fish, crabs, and other shell fish.

At Fala-Beguets Island the natives are fairly well supplied with fishing implements. They have a few canoes and are able to do some hand-lining inside the reef. Usually three or four men fish together from one canoe. We found several schools of mullet eight to ten inches long and near shore, but very wild. There was an ample supply of epino nets and most of the natives had goggles and spears. In general fish are very scarce here, as two men came in from hand-lining with only four fish six inches long.

As indication of the scarcity of fish here is the fact that we spent one and a half hours searching the reefs for fish and shell fish and in addition to the mullet mentioned

above obtained only a few small goat fish (Mulloidichthys auriflamma) six inches in length, a parrot fish (Leptoscarus) 18 inches long, and a spiny lobster (Panulirus) of about one pound in weight. We saw several small schools of the anchovy (Anchoviella) used as a bait fish.

In view of the shortage of protein food the natives eat all kinds of shell fish available. Most of the shell fish are either eaten raw or roasted. Among their main sources are the trochus, both the commercial species imported by the Japanese and their own smaller native species and Cardium, called kitir and nitchik by the natives. They also eat three species of the giant clam (Tridacna gigas, crocea, elongata) and the mule foot (Hippoppus). Practically all of these shells are ruined for commercial purposes by roasting or by mutilation from cracking in order to get the animal out.

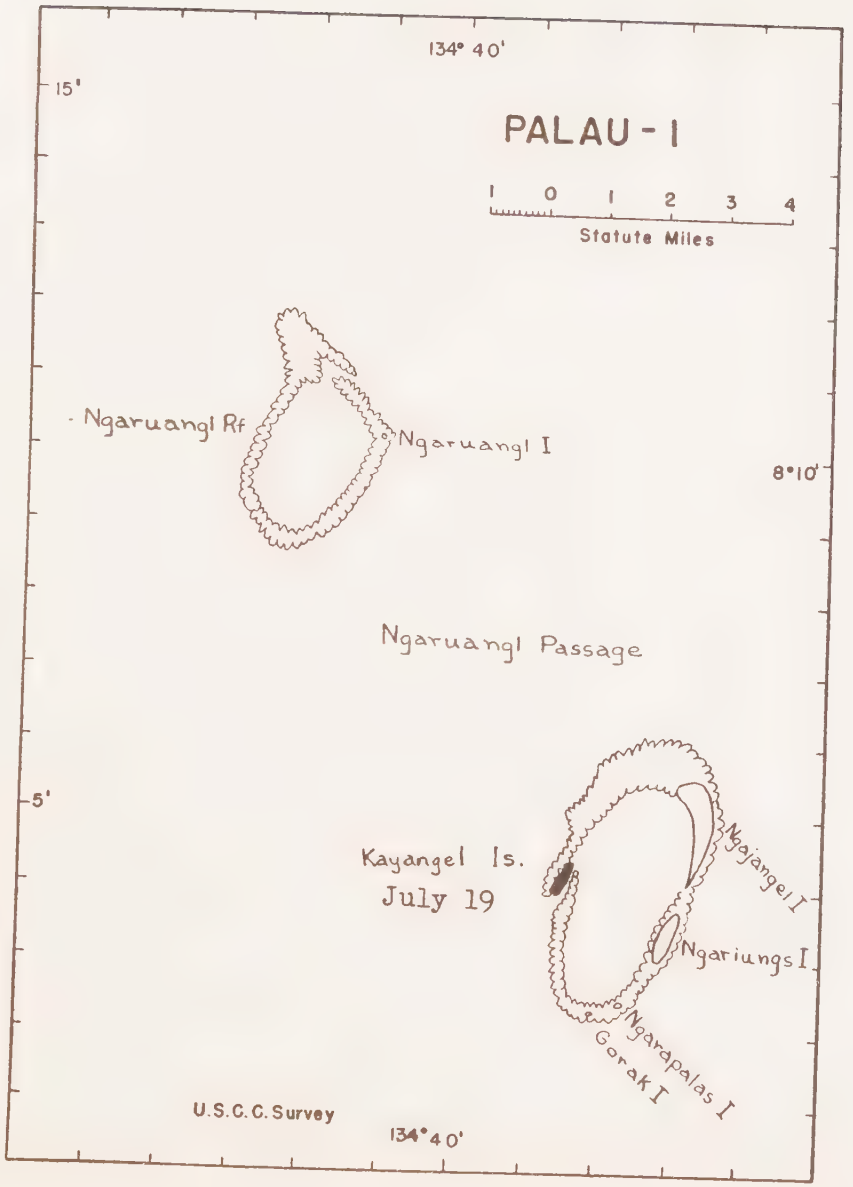
On June 3 an examination was made of the reefs around Pis Island. Probably because of its distance from the main Japanese base on Dublon Island this island has more fish than any of the others in the Truk group. Using spears we obtained several blue parrot fish (Leptoscarus) of small size ranging up to ten inches. These were very wild fish and difficutl to approach. There were also a number of schools of small goat fish six to seven inches in length. Also common were small crevalles (Caranx ignobilis) about ten inches in length, and the milk fish (Chanos chanos). Unfortunately the reef and the area between reef and shore are very rough around this island and there are no places where either seines or throw nets can be used. We also saw a number of schools of the bait fish (Anchoviella purpureus) which seemed to be plentiful enough to support a moderate commercial fishery except for the difficulty of catching them. There are plenty of spears and the women use the small hand net (epino). Training in the use of the spears begins at an early age as we saw a number of boys six to ten years of age using spears in shallow water inside the reef. Red striped crabs (Grapsus grapsus tenuicrustatus) are abundant. We also found three species of the giant clam (Tridacna gigas, crocea, and elongata). The so-called mule foot shell (Hippoppus hippoppus) is also abundant as were trochus, especially the small native type. One of the epino nets which we examined had a mesh one-half inch square.

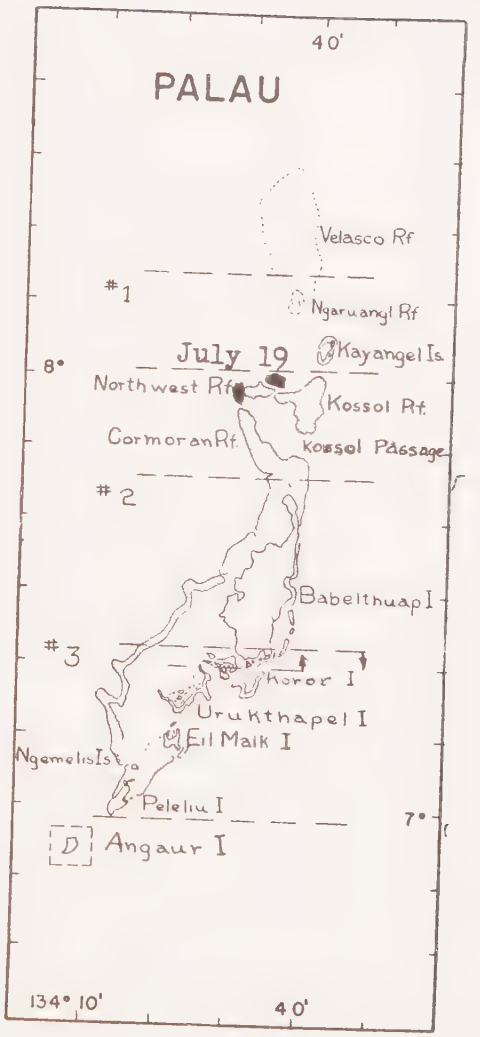
This island seemed to have more seafood around it than all the others put together. In addition several flocks of birds were working along north pass which generally indicates feeding fish underneath. We were unable to do any trolling outside ourselves, as the vessel assigned to us was not allowed to go outside the reefs.

Unlike most of the other islanders, the people at Truk do not use the small decorative shells such as "monkey face" and "gold ringers" to make handicraft items such as headbands, necklaces, and bracelets. A few are used as fastenings on baskets.

Note on Bonito Industry on Truk

Although the Japanese produced considerable quantities of dried bonito sticks at Truk, operated a number of boats, and had refrigeration and other shore facilities on Dublon Island, our best information is that natives were very seldom employed in the industry. Their only employment was that women were used to a limited extent in the processing plants, but in the matter of catching fish the crews were entirely of Okinawans or Japanese. Sampans ranged in size from 40 to 55 feet and carried crews of over 20 men. The fishing was limited by the amount of live bait which could be obtained. Although some fishing was carried on throughout the year, the supply of live bait made it necessary to curtail operations during the period from March through June. The largest catch was, therefore, during the period from July through February. Two types of live bait were used, the first being a small anchovy (Anchoviella purpurea) one to two inches long called seribu by the natives of Truk; the second species was a small red or pink species, from two to three inches long, called tiribu by Trukese and takabe by the Japanese. As none was obtained, scientific identification can not be made. (For further reference, see Part II-I Bonito Industry.)


134° 40'
15'
PALAU - 1
1 0 1 2 3 4
Statute Miles
Ngaruangl Rf
Ngaruangl I
8°10'
Ngaruangl Passage
5'
Kayangel Is.
July 19
Ngajangel I
Ngariungs I
Ngarapalas I
Gorak I
U.S.C.C. Survey
134° 40'


40'
PALAU
Velasco Rf
#1
Ngaruangl Rf
July 19
Kayangel Is.
8°
Northwest Rf
Kossol Rf.
Cormoran Rf.
Kossol Passage
#2
Babelthuap I
#3
Koror I
Urukthapel I
Eil Malk I
Ngemelis Is.
Peleliu I
7°
D
Angaur I
134° 10'
40'

PALAU - 2
1 0 1 2 3 4
Statute Miles
25'
134°30'
35'
Ngarequr I
To
Kayangel
Ids.
Ngarekeklau I
Ngamegei Passage
Oiei
Ngebei
Pkulrengerelong Pt
Agolo
Arekalong
(Ngerechelong)
Peninsula
40'
Aiwokario Passage
Achelap
Ngardmau
Bay
Ngardmau
Pt.
Galap Pt
Ngebuked
Urdmau
Ulimang
Pkulagalid
Pt.
7°35'
keklau (Ceklau)
35'
Ngerecheluk
Toagel Mlungui
Pkulataprival
Namai Bay
Pkulngrid
Ngercmetonal
30'
Melekeiok Pt
Melekeiok
(Melekcok)
Ngatpang
(Ngedbang)
Ngatpaet Passage
BABELTHUAP
ISLAND
Medorem
Pkurengel
Trolled
July 17
To Kayangel
Ids.
Ngarekedai
(Ngerégeai)
25'
7°25'
KOME BAIL
LAGOON
Namelakl Passage
July 8
Ngoissagang
(Ngarngesang)
Goikul
(Oigul)
Ngurur I
Ferry
ARAKABESAN I
Nardueis I
Korak I
20'
Garreru I.
35'

Ngurur I
Koror Harbor
BABELTHUAP I
ARAKABESAN I
Kobasang Harbor
Koror
July 9
D-S
Toaĝel Mid (Passage)
Auluptagel
Ngell Channel
Ngadarak Reef
Malakal Pass
Trolling
July 25
D-S
Ngobasangel I
July 10
D-S
Augulpelu Reef
UROKTHAPEL I
Kre.s (Kasao) Reef
Sar Passage
IL MALK
July 12
D-S
Abappaomogan I
(257) (308)
Ngemelis Islands
Pelugauar I
Ngeregong I. Denges Passage
Ngarklim I
Ngergoi I
Ngerugelbtang I
Ngargersiul I.
Ngabad I
PELELIU I
Warmokid I
PALAU - 3
1 0 1 2 3 4
Statute Miles
D-Diving
S-Spearing
TR-Trolling
Numbers in red show approximate areas of culture pearl operations:
Pearl Industry Co. Laid Used
1. Mikomoto 1930 to end of war
2. Kimisuisan 1930 abandoned
3,5,6 South Seas 1939 (5&6) to war's end
4. Pacific Ocean 1930 not used for some time
ANGAUR I
6°57'
134°10'

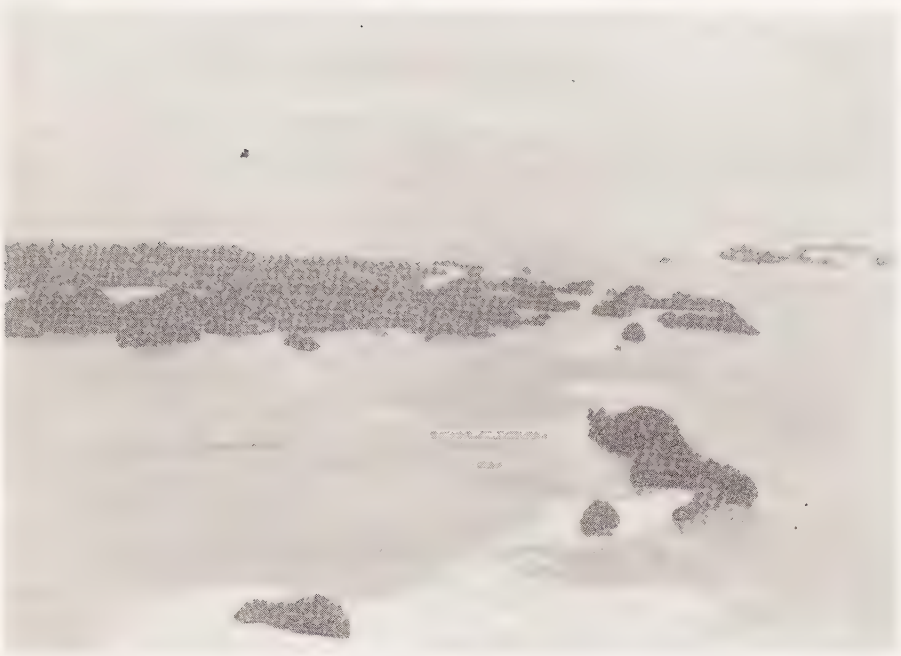


Figure 20... Palaus. Terrain between Koror and Peleliu. July 1946.

Figure 21... Palaus. Typical undercut cliffs on islands between Koror and Peleliu. July 1946.

Figure 22... Palaus — Koror. Site of Japanese Marine Fisheries Experiment Station. July 1946.

Figure 23... Palaus — Koror. Bombed bridge blocking navigation. July 1946

F. PALAU ISLANDS (Population 6018 - 1946)

1. Peleliu
(July 6)

Lack of time prevented a survey of the fisheries in this section. On the east side of the island the fringing reef is close inshore, while on the west side itis in some places several hundred yards offshore. There is a considerable area suitable for fishing. Because of the shortage of throw nets and other types of gear, the natives obtain most of their fishery products by spearing and diving. Shell fish are taken mainly by women and children by picking them up by hand on the reefs at low tide.

Peleliu cannot be considered of any importance as a base for offshore fishing operations, both because of lack of water, and port facilities are not sufficient for the handling of large vessels. As long as the island is devoted chiefly to a military establishment and large numbers of natives are employed on military projects, there can be only limited subsistence fishing. It is not considered necessary to make a thorough study of the fishery resources in the Peleliu area.

2. Koror
(July 8-25)

Koror was the most important Japanese fishing base for offshore operations and the site of their marine experiment station (Fig.22), which operated from 1933 until the war began. Four Japanese companies were engaged in the growing of culture pearls and a number of pearl shell luggers used this as a base of operations for their fishing in the Arafera Sea. Large quantities of trochus shells for perarl buttons, and dried sea cucumbers (trepang or beche-de-mer—Fig. 31), were exported to Japan. Decking facilities were constructed for loading and unloading large freighters, and utilities such as water and electricity were provided for the population of 25,000. Marine railways and repair yards were capable of handling ships up to a hundred feet. A paved causeway to Arakabesan Island and a bridge to Malakal Island were capable of carrying heavy vehicular traffic. All of these installations were either destroyed or damaged beyond repair by bombing and strafing (Fig.23). Regardless of the damage to buildings and installations ashore, Koror must still be considered the most important site for rehabilitation of the fisheries of the former mandated area.

One resource not duplicated elsewhere is the large number of native fishermen who are accustomed to diving and spear fishing outside the reefs and who are anxious to undertake at least a limited amount of offshore fishing, especially for bonito. Although they had a comparatively small part in the former Japanese operations, they are essentially skilled fishermen and it is believed that it would not take more than six months of expert training in order to make them capable of taking complete charge of the fishing operations. It would be necessary to bring in technical personnel--probably from Japan or Okinawa--to give training, both in actual fishing methods and in preparation of the dried bonito sticks which would be the main source of income.

At the time of the survey, even subsistence fishing was on a restricted scale. During the war the natives were prevented from fishing on the outer reefs and as a further security measure the Japanese destroyed as many of the native canoes as they could find. Present estimates are that prior to the war the natives had in the Palaus approximately 1,500 sailing and paddling outrigger canoes (Fig. 26). At the present time there are less than a hundred.

Since the barrier reef is from three to ten miles offshore, most of the natives find it necessary to fish only on the fringing reef close to shore (Fig.25). Their main reliance is on shell fish. Crabs, especially the large Samoan crab (Scylla serrata) and spiny

Fig. 24... Palaus - Koror.
Giant clam shell. July 1946.

Fig. 25... Palaus - Koror. July 1946
Spear fishing inside barrier reef.

Fig. 26... Palaus - Koror. Paddling Canoe. July 1946.

Fig. 27... Palaus - Koror. Spiny Lobsters. July 1946.

Fig. 28... Palaus - Koror. One man's catch, two hours of spearing. July 1946.

Fig. 29... Palaus - Koror. 25 pound Blue wrasse (Cheilinus undulatus) from outer reef. July 1946.

lobsters (Fig. 27) are abundant. Even so, the total catch of fish is well below requirements. So anxious were the fishermen for an opportunity to go to outer reefs that we always had more volunteers than could be used. Usually we took from 11 to 14 native fishermen with us. All of them had their own spears and goggles. In addition, each man carried a small purse-like basket woven of coconut fronds, and a piece of string or wire on which to string his fish. In the course of two hours of fishing on the outer reef the average catch per fisherman was around 25 pounds of fish and from two to ten pounds of shell fish (Fig. 28).

None of the fishes in the Palaus is regarded as poisonous, although several are not eaten because of taboos. Hence, most species contribute to the native diet. On the reefs the more important species are groupers, snappers, parrot fish, wrasse (Fig. 29) damsel fish, and goat-fish. The most important shell fish is the giant clam (Tridacna). Smaller sizes of these giant clams up to 12 inches are abundant. There are also a few of the larger ones up to 36 inches (Fig. 24). The information is to the effect that the Japanese shipped back to Japan approximately 1,000 pairs of shells from the larger size tridacna and these were found to be comparatively scarce. The natives do not bring in the shells, but sever the adductor muscle of the clam in its position on the bottom and simply extract and bring in the meat.

Trochus shells from three to five inches in diameter at the base are abundant as are the rough cat-eyes. Black lip pearl oysters were rather scarce. However, the native divers usually do not go below two fathoms and very few of them will go beyond four fathoms. There can be little doubt but that a large spawning reserve of both fish and shell fish exists below the four fathom mark.

Trolling also yielded good results. We always had a large white feather jig with a Sobey #11 hook and a brass #6½ or #7 spoon behind the boat while we were under way. The spoon caught approximately three fish to each one caught by the feather jig. The combined catch for both feather and spoon ranged from 10 to 25 pounds of fish per hour. The main species taken were crevalle, barracuda, bonito, and occasionally a snapper or grouper (Fig. 30). The crevalle, snapper, and grouper weighed from four to eight pounds; the bonito from five to ten pounds, and the barracuda from six to 25 pounds. All of this trolling was done inside the barrier reef.

Excluding the offshore fisheries, the development of which requires outside capital and shore facilities, there remain several local sources of income which can be developed immediately and without the necessity for outside financing. These include trochus, trepang, black lip pearl shells, giant clam shells, other decorative and curio shells, and possibly the culture of pearls.

A start has already been made in collecting and preparing trochus shells for marketing to pearl button manufacturers. Several thousand shells were collected during the present season, which, due to the special situation existing, ended on August 31. Normally, the pre-war regulations should be in effect, which required the taking of these shell fish only during the months of May and June, and usually only for a two-week period in one or the other of these months. The Palau chiefs have declared the Japanese regulations to be in force, but no supporting action has been taken by Military Government. The trochus is a large marine shell, reaching a width at the base of approximately six inches and a maximum height of five inches (Fig. 46). These animals are usually found on the sides and roofs, or in crevices, of the caverns at the outer edge of the barrier reefs, in depths ranging from one to three fathoms. In preparation for market, a part of the animal is removed with a small hook and the shells are then buried in dry sand for a period of a month or so, or may be left in sea water for a week or so until, in the former case, ants have eaten the remaining meat portion from the shell, or, in the latter case, decomposition has softened it so that it can be removed. The shells are then dried and a layer of encrusting coral which covers all of the shell is carefully knocked off. On most of the shells the

Fig. 30... Palaus - Koror.
Bonito and Crevalle taken on spoon. July 1946.

Fig. 31... Palaus - Koror.
Types of trepang produced by natives. July 1946.

Figure 32... Palaus - Koror. Equipment for culturing pearls. July 1946.

Figure 33... Palaus - Koror. Baskets holding black-lip oysters for pearl culture. July 1946.

tip of the spire has been riddled by marine boring worms. If the infestation has been extensive and appears in more than 10 percent of the shell area, the shells either bring a lower price of may be discarded entirely, as they are unsuitable for button making. As a conservation measure, the Japanese prohibited the taking of any shells less than three inches in diameter at the base and this regulation should be rigidly enforced in the future.

Sea cucumbers of many varieties are common throughout the Palaus, but are eaten to only a limited extent by the natives. The Japanese, however, not only used large quantities locally, but prepared trepang for export to Japan. Several natives at Koror are now engaged in preparation of trepang and with proper guidance in preparation of the desired qualities and with assistance in marketing, it should prove a good and steady source of income for a number of natives throughout the year. The process itself is a simple one and consists of boiling, eviscerating, and drying the sea cucumbers. The drying may be done in an easily constructed oven, but care must be taken to avoid spoilage while in warehouses awaiting transportation. The main types of trepang now being prepared at Koror are shown in Fig. 31.

There has always been a limited market for giant clam shells, due to use for bird baths and baptismal founts. If a definite outlet could be found for some of these shells, they could be taken in the course of other fishing. One of the main problems is that of packing and shipping, as each of the valves of the shell frequently weighs more than a hundred pounds.

Decorative and curio shells, such as the cowries, the helmet shell, and the trumpet shells, are abundant and are taken by the natives in the course of their regular fishing. Probably many more could be brought in than are at present. However, it is necessary to exercise considerable caution in encouraging this particular project for the reason that all of these shells are fragile. They require special packing and handling and it is believed that no attempt should be made to supply the American market from the Palaus. Whatever quantity can be sold, either locally in the Palaus or at Guam, could be handled. Under present conditions it is doubtful if it would be economically sound to attempt to ship such shells clear to the United States.

Black lip pearl oysters have always been in demand for the manufacture of buttons, shell inlay in wood, and for buckles and various carved pieces of ornamental jewelry. The supply of these oysters in the Palaus is believed to be considerable, although scattered over a wide area. As more canoes are constructed by the natives and they are able to travel more widely in their fishing operations, they should be able to obtain quantities of these shells in the course of their regular operations. No data are available on which to base estimated annual production. The rate of growth of this pearl oyster is not known, but it is thought to be comparatively slow and that from seven to twelve years may be required to reach maximum size of around eight or nine inches in diameter. Conservative measures are essential to prevent depletion, and until better information can be obtained it is recommended that no black lip pearl oysters be taken under four and a half inches in diameter. Individuals examined in Koror in July were full of ripe spawn at that time. Pending further knowledge, it is recommended that there be a closed season on the taking of these oysters during the period June 1 through August 31.

As early as 1930, four Japanese companies were engaged in experimental production of culture pearls from the black lip oyster in the vicinity of Koror (Palaus). These were the Mikimoto Pearl Industry Company, which was still in operation during the war; the Kimi Suisan Pearl Industry Company, whose holdings were in the harbor and were abandoned on account of harbor dredging; the Pacific Ocean Pearl Industry Company, who also began operations in 1930, but who had abandoned the work before the end of the war. The last was the South Seas Pearl Industry Company, which was in operation to the end of the war and known to have made plantings of pearl oysters as late as 1939. The extent and success attained by these companies is not known. At the time of our visit all of the oysters with culture pearls had been taken up, either by the Japanese, or by the natives subsequently. There were reports of one deep water planting in from 20 to 25 fathoms, which,

if it exists, could only be examined by the aid of deep sea diving equipment not available to us. The approximate location of each company's cultured pearl operations is indicated on chart Palau 3, page 36.

There is one native on Arakabesan Island who states that he learned from the Japanese the process of inserting pearl blanks into the oysters for pearl formation (Fig. 32). In partnership with another native he has already put out approximately 150 baskets of black lip oysters, each basket holding ten oysters (Fig. 33). None of the blanks had been inserted in oysters at the time of our visit. The progress of this enterprise is worthy of attention. No financial assistance will be required, as there are plenty of baskets left over from the Japanese operations and the natives will be able to obtain the necessary number of black lip oysters locally and mostly by their own efforts.

The process in principle is a simple one. The black lip pearl oyster, from four to six inches in diameter, is opened mechanically and a blank bead made of pearl shell is inserted in the mantle through a very small incision made with a small scalpel. The incision is then closed and the oyster is put in one of the baskets and left for three years, at the end of which time the blank bead is thoroughly covered with the nacre which gives the pearl its lustrous appearance. It has been the general impression that a very small particle was inserted, around which the oyster built the pearl. This is far from being the case. Actually, the blank beads are all approximately the final size of the pearl. They are graduated in size so that if 50 pearls are needed for a necklace, the appropriate sizes can be obtained from 50 different oysters. The actual thickness of the layer of nacre laid down by the oyster is quite thin. It was impossible to get any definite information as to whether or not the Japanese put more than one blank bead in each oyster. The natives intended to put only one blank in each oyster. Their plantings are in from two to five fathoms of water. One problem which will face this budding industry is that of obtaining additional pearl blanks when their present stock is exhausted. There were thousands of these blanks at Koror, but most of them have been damaged by fire. The blanks appear to have been made either from the large white pearl oyster shell, or from giant clam shells. Information is to the effect that glass beads cannot be used, as the nacre does not stick tight enough to the glass. Some of the instruments used for the operation of inserting blanks into the pearl oyster are shown in Fig. 32.

If the present native experiments are successful, there is ample space for expansion to produce thousands of pearls annually.

There is a sufficient supply of large trees in the Palaus to provide for the necessary number of new outrigger canoes, both sailing and paddling. There has not been very much boat building up to the present time because large numbers of the natives were left homeless and their first consideration has been to build a house for themselves and their families. It will certainly be another 12 months, possibly longer, before boat building can be undertaken on a large scale. In the meantime inter-island transportation of passengers and freight is completely dependent on the few Japanese motor boats of 30 to 40 feet and powered by single cylinder, semi-diesel engine with the blow torch starting. Most of these vessels are in very bad repair, both as to hull and engines. Unless some means can be found to repair or replace some of the hulls and to service the engines, there will be a complete breakdown of the local transportation system within 12 months. Another factor to be considered is that these semi-diesel engines have been operated on a lower grade of fuel oil from Japanese military stocks and will not operate on regular United States Navy fuel oil of 50 cetane. Most of the stocks of Japanese diesel oil are nearly exhausted and unless the engines can be modified to burn standard United States Navy fuel, these vessels will have to be tied up. Navy vessels cannot be used to replace the Japanese type for inter-island traffic unless operations are taken out of native hands and financed and operated by the Navy. Naval vessels are unsuitable in design for this type of service and their cost of maintenance, operation, and repairs are beyond the means of the natives. The best solution of the problem appears to be to modify the fuel system of the Japanese semi-diesels so that they will use U. S. Navy fuel.

Fig. 34... Palaus - Kayangel Island jig made from inner stalk of Spider Lily (Crinum asiatica). July 1946.

Fig. 35... Rota. Area between shore and fringing reef. Low tide. June 1946.

Note on Marine Fisheries Experiment Station

If it should become possible to carry out biological studies of the fisheries in the former mandated areas, it is recommended that special consideration be given to Koror as a site for headquarters. Nothing but the foundations and parts of walls remain of the Japanese marine fisheries experiment station at Koror, and it is doubtful if even the foundations would be of material advantage in constructing a new station. The Japanese structures were of reinforced concrete and included, in addition to laboratory and office space, several large outdoor tanks filled with sea water, and fairly large refrigeration space amounting to probably 10,000 cubic feet. Attached to the station were various auxiliary shops, such as machine shop, carpenter shop, and storage and repair facilities for netting and other fishing equipment.

Schools of bait fish are abundant along the shores of many of the islands in the group.

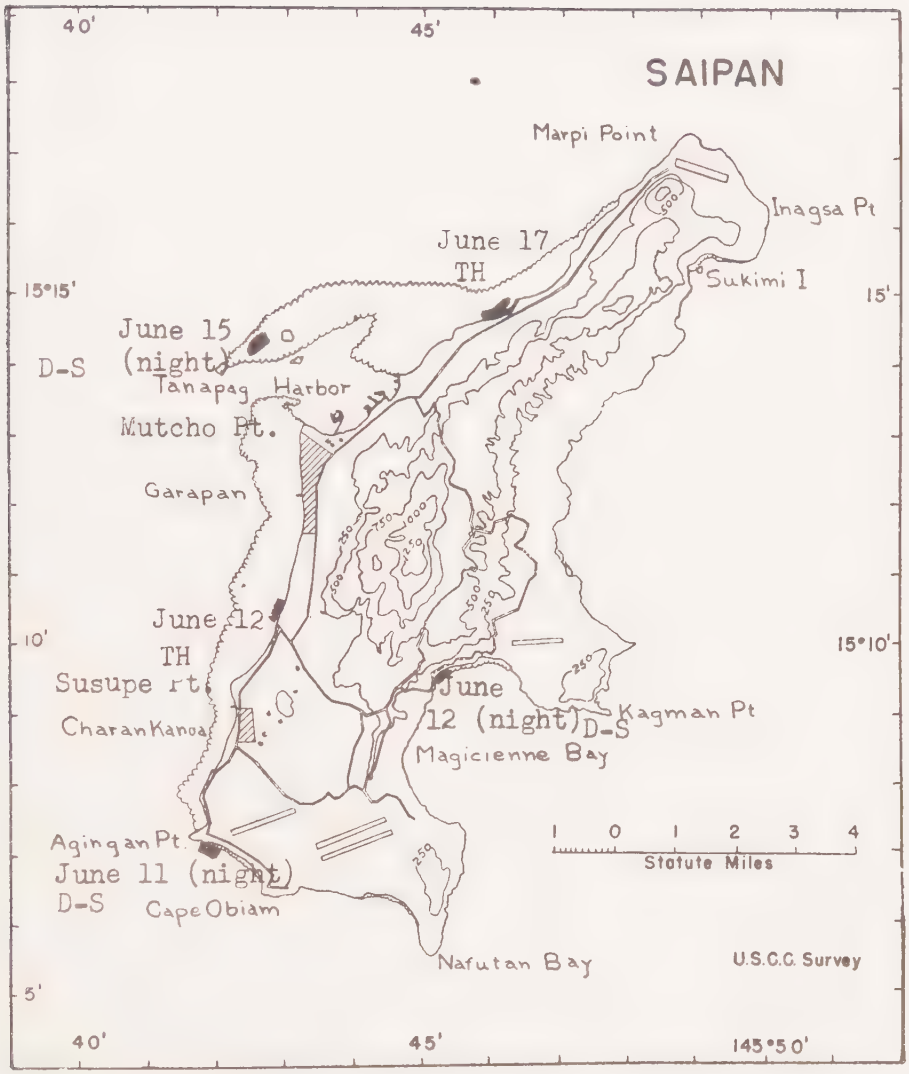
In 1939 the Japanese operated 45 motored fishing vessels of 30 to 45 feet in length in the Palau district. Practically all of these were engaged in the bonito drying industry.

3. Kayangel Islands
(July 18-19)

There are four islands in the group, lying about 30 miles north of Babelthuap. These are low islands and only the largest one is inhabited, the population being around 130 persons. The barrier reef is from one to four miles offshore. From a subsistence standpoint these islands are much better provided for than any others in the Palau region. The small population is insufficient to make any inroads on the marine resources and there was no dynamiting by enemy garrisons, nor was there bombing and strafing by our forces. There is no shortage of sailing or paddling outrigger canoes and breadfruit trees are available for the construction of replacements. Most of the fishing is done by diving and spearing, with a limited amount of trolling. There is practically no smooth bottom around the islands suitable for beach seining. Cast nets are rare, due to lack of twine for knitting them. The spears are made from either 1/4 inch or 3/8 inch steel rod, about 24 inches long, with a double barb on the point set into a bamboo shaft from six to ten feet in length. These spears float. Due to the abundance of fish and shell fish, there is no shortage of protein food. Sea cucumbers are sufficiently abundant to warrant a limited production of trepang. Large trochus are abundant on the outer reef and black lip oysters from four to six inches in diameter are common in from two to four fathoms inside the barrier reef. Decorative shells, such as the cat-eye and several species of cowries, are very abundant. Of the larger curio shells, the spider, helmet, and trumpet shells are occasionally taken. Spiny lobsters are also very common. Octopi are occasionally taken and greatly relished by the natives.

Excellent catches were made, both inside and outside the reef, by trolling. Close to 60 pounds of fish were taken per hour by trolling. These were mainly crevalle from four to 10 pounds in weight, wahoo from 10 to 12 pounds, and barracuda from 10 to 20 pounds in weight. The natives make their own jigs, similar to the white feather jig, from the white inner pulp of the so-called "spider lily", (Crinum asiatica) which is quite effective. The jig is illustrated in Fig. 34. It proved especially good for barracuda and for this species was almost as good as our brass #6½ and #7 spoons in total poundage taken.

At the time of the survey there was no actual shortage of fishing gear or supplies with which to maintain a subsistence diet. In order, however, that there may be no shortage in the future, it is essential that supplies of steel rods 1/4 inch and 3/8 inch diameter should be furnished for making spears and an assortment of hooks, swivels, leader wire, and seine twine for making throw nets, and larger size of cotton twine for hand lines; brass and silvered spoons of #6½ and #7 sizes, preferably of the types known as "Diamond" and "McMahon". A small assortment of these items could be sent to the trade store for use as required in replacements.



D-Diving
S-Spearing
TH-Throw Netting

III. THE MARIANA ISLANDS

A. SAIPAN ISLAND (Population +4600 - 1946)
(June 12-17)

The fringing reef on Saipan is in some places over a mile offshore, forming a broad inshore area suitable for beach seining and throw netting. The native population on Saipan is somewhat in excess of 4,600 persons, and since they traditionally consume nearly a pound of fish per person per day, there is a steady market for fishery products. Due to the general shortage of labor, most of the natives are employed by the armed services in one capacity or another. Only 80 men are available for work in the fisheries. Approximately 50 of these are engaged in offshore fishing for bonito on two Japanese sampans.

Under the Japanese, the bonito fishery was entirely in the hands of Okinawan or Japanese fishermen and no natives were allowed outside the reefs. When these experienced fishermen were repatriated, there remained available on Saipan four sampans from 55 to 65 feet in length, with necessary operating gear such as bait nets, poles, and hooks. Two of these vessels are nowin operation with all native crews. A thorough description of the methods used will be found in the Fisheries section (Part II-IC), since it may become an example for operations by natives in some of the other islands, particularly in the Carolines.

Several night surveys were made of reefs at various parts of the island, especially to determine the abundance of spiny lobsters, sea cucumbers, and trochus shells, all three of which are more easily located at night than during the day time. The local native method of hunting the spiny lobster is to use either a coconut frond torch or a Coleman gasoline lantern and walk along in shallow water not over three feet deep and when a lobster is located to pin it down with a forked stick. Two fishermen work together on this, one carrying the torch, the other the forked stick. A method which we found much more successful than the regulation torching was to swim with navy battle lanterns under water, as visibility is much better and the crawfish, being largely blinded by the glare of the light, can be caught by hand.

In contrast to the scarcity of fish inside the reef, we found the holes and caverns at the outer edge of the reef well populated with surgeon fish, red squirrel fish, crevalle and parrot fish. As long as there is the labor shortage on Saipan, these fish cannot be made available to the native population, as they can be taken only by spearing, or by the use of hand lines from outside the breakers. As the natives are employed daily by the armed services, they will have no opportunity of going to these reefs. Many Chamorros have spears, goggles, and seven-foot throwmets. The latter have a very small mesh, close to 1/8 inch square bar. They are used along the sandy beaches and the catch is generally small goat fish three to four inches in length and occasionally mullet up to 10 inches in length.

A night survey was made of the reef which lies off Maniagassa Island. With the assistance of four native divers, a strip 60 feet wide and half a mile long was covered on the inner side of the reef. The depth of water varied from two to five feet. Using diving goggles and navy battle lanterns carried under water, the section was carefully covered. Spiny lobsters were common, but we obtained only two which were large, weighing two and a half and three pounds and being 18 and 20 inches in length. Trochus were very abundant. Taking only the largest shells, at least four inches in diameter at the base, they were picked up at the rate of 25 an hour. There were many large trochus shells inhabited by hermit crabs, and it is reasonable to suppose that they had perished from old age.

Sea cucumbers were very abundant. The large yellow ones up to 14 inches in length were common, as were the large, black, smooth ones up to 24 inches in length. Fairly

D-Diving
S-Spearing
TH-Throw Netting
TINIAN
1 0 1 2 3 4
Statute Miles
35'
40'
5'
15°
55'
50'
Ushi Pt
Asiga Pt
Hilo Pt
Maya
456
Lasso
564
Chüro
Asiga
(190)
Raso
Kahi
June 8 (night) D-S
June 10 (day)
D-S-TH
Masalog Pt.
Gurguan Pt
June 9
D-S-TH
246
Marpo
Farm
Tinian Town
(Ruins)
Marpo Pt
531
Poporu
Tinian Channel
Lalo Pt.
Tatsumi Reef
584
Aguijan I
Naftan Rock
145°35'
U.S.C.G. Survey

common were large, black, spiny ones up to 12 inches and smooth black ones to eight inches. Brown spotted groupers to 14 inches were abundant, and very common were two kinds of red squirrel fish, one solid red, Myripristis murdjan, and one with white longitudinal stripes, Holocentrus diadema. Both of these were about eight inches in length.

On the leeward side of the island, in the section from shore out to the reef, there are many patches of edible sea weeds of the branching type (Gracilaria sp.), about six inches high.

Giant clams of the species Tridacna elongata were common, but rarely exceeded six inches in length. Small decorative shells used in handicraft were rare, with the exception of Cypraea moneta.

A number of fish are considered poisonous. Among these are large crevalle (Caranx sp.) and most red fish; also all of the fish on the outside reef. On the inside of the reef it is considered that any black fish (presumably surgeon fish) are poisonous and, of course, all puffers are discarded. The black tipped sand shark, (Eulamia melanapterus) is not eaten.

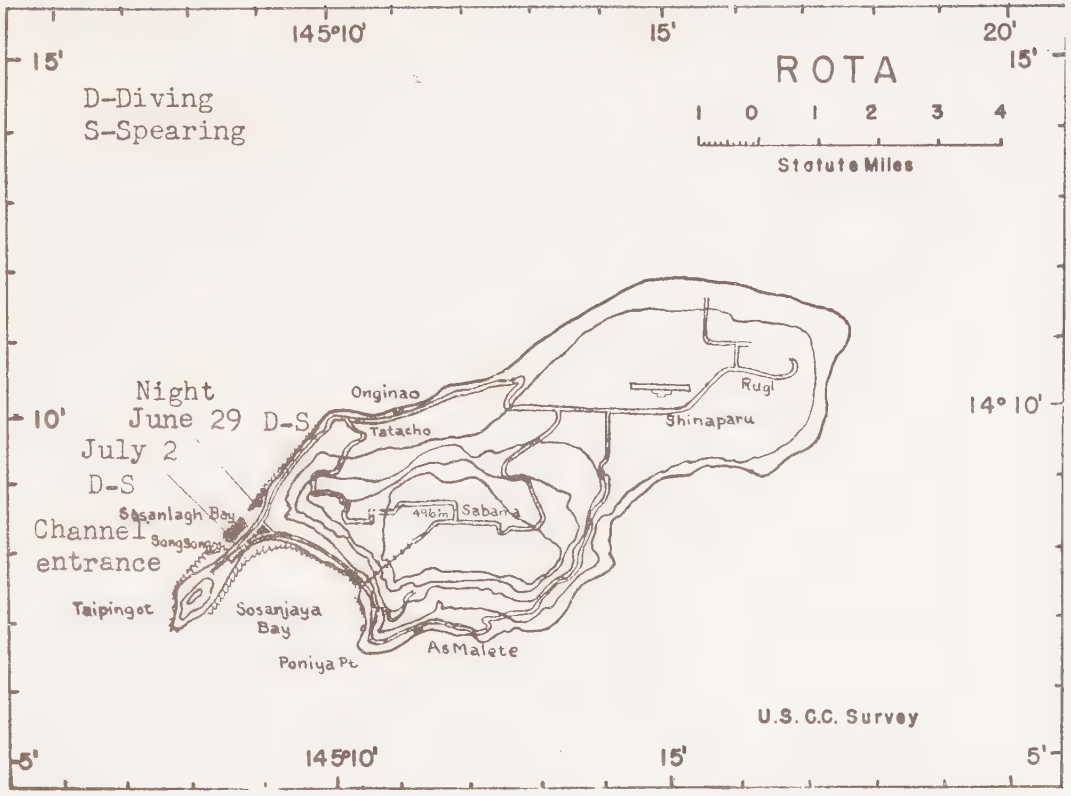
B. TINIAN ISLAND (No native population - 1946)
(June 8-10)

From a fishery standpoint, the most striking topographic feature of Tinian is the lack of barrier or fringing reefs, particularly along the east or weather side of the island. Here the surf breaks directly against rock cliffs of the island itself and there is no rocky plateau along the shore. This is in part true of the western or lee side of the island, except that the surf is not as high and there are sections where there is a limited fringing reef.

At the time of our visit there were no native families living on Tinian. The fishery was in the hands of Okinawans, but was not being actively prosecuted because the Okinawans were to be repatriated within 10 days. Since it might serve as a useful pattern elsewhere, it may be stated that the Okinawans conducted their fishery on a cooperative basis. One group, using a Japanese sampan, fished offshore for bonito and tuna. The other group, using two Okinawan canoes and a beach seine, fished inshore. The catch was sold at prices ranging from five to ten cents a pound, which was sufficient to provide a good source of income to the fishermen and still supply the remainder of the population with the protein food at prices which they could afford. Our only examination showed that the inshore areas were well populated with fish. Mullet 10 to 12 inches in length, and goat-fish (Mulloidichthys, Pseudupeneus) six to eight inches in length were abundant, although rather wild and difficult to approach. Spiny lobsters, Panulirus marginatus, were abundant on the reefs at night and can be taken by torching. These lobsters ranged in length from nine to 16 inches and averaged slightly over a pound each. The female lobsters were carrying bright orange eggs on their swimmerets. This species differs from that found along the southeastern United States coast in that the head and thorax portion are much larger in proportion to the total length than is the case with the United States variety. Consequently, the central Pacific lobster does not have as much meat in proportion to total length as the United States variety does.

Thread fish (Polydactylus sexfilis), are surgeon fish (Hepatua sp.) were abundant. The former ranged in size from 10 to 12 inches, while the latter were approximately eight inches in length.

The chief characteristic of the inshore area from the fringing reef to the high water line on shore is the lack of living coral. The bottom is of very fine white coral sand, with occasional dead coral heads protruding from the bottom. Such an area is well adapted to the use of throw nets and in some places beach seines can be used. This condition is characteristic of the Marianas as compared with the Carolines and Marshalls.


145°10'
15'
20'
ROTA
D-Diving
S-Spearing
1 0 1 2 3 4
Statute Miles
Night
June 29 D-S
July 2
D-S
Channel
entrance
Onginao
Tatacho
Rugi
Shinaparu
496m
Sabana
Sasanlagh Bay
Songsongan
Taipingot
Sosanjaya
Bay
Poniya Pt
As Malete
14° 10'
10'
5'
U.S. C.C. Survey

40'
45'
50'
144°55'
RITIDIAN PT.
UKUNO PT.
NW FIELD
TARAGUE
PATI PT.
35'
HAPUTO PT.
NORTH FIELD
ANAO PT.
AMANTES PT.
MT. SANTA ROSA 910
YIGO
DEDEDO
TUMON BAY
SAUPON PT.
HAGMON FIELD
30'
PAGAT PT.
AGANA BAY
TH June 26
AGANA FIELD
CABRAS Is.
ASAN
PITI
BARRIGADA
APRA HARBOR
SINAJANA
OROTE POINT
U.S.C.C. FARM
FADIAN PT.
MT. ALUTOM
MT. TENJO
TAOGAM PT.
PAGO BAY
25'
13°25'
YONA
AGAT BAY
SANTA RITA
AGAT
YLIG BAY
TOGCHA BAY
Mata
FENA
FACPI PT.
MT. LAMLAM 1334'
TALOFOTO BAY
13°20'
20'
UMATAC
UMATAC BAY
MT. BOLANOS
MT. SASALAGUAN
INARAJAN
PORT INARAJAN
AGFAYAN BAY
CG Dock
MERIZO
15'
June 22
AJAYAN
Cocos Is.
June 24
D-S-TH
GUAM
Statute Miles
D-Diving
S-Spearing
TH-Throw Netting
U.S.C.C. Survey

In both the latter groups there is a tremendous growing population of brain, mushroom, staghorn, and other branching corals. Around most of Tinian there is a bluff from 10 to 40 feet high, rising abruptly along the shore, and consequently there are no mangrove swamps. Small decorative shells which might be used for handicraft are rare.

Along the outer edge of the reef there is a large population of fish among which the most common are parrot fish (Callyodon sp.), mullet, goat-fish (Mulloidichthys and Pseudupenaus), and crevalle (Caranx sp.) to three feet in length; octopi are occasionally to be found, and yellow sea cucumbers are abundant. Schools of anchovies (Anchoviella purpureus), used as live bait for bonito, are abundant under the bluffs. Small flying fish from three to six inches in length are very abundant also.

All of our observations indicate that Tinian would prove to be a very good site for an extensive bonito fishing fleet. Probably as many as 10 or 12 fishing vessels could be accommodated there.

C. ROTA ISLAND (Population +800 - 1946)
(June 29-July 2)

The fringing reefs around Rota are mostly only a few yards offshore (Fig. 35). Consequently, there is a comparatively small inshore area from which fish may easily be taken. The Japanese operated one sampan, which brought in fresh bonito to feed the garrison, Japanese civilian, and native population. Any surplus was dried. The natives were employed on the sugar plantations and were not allowed to go outside the reef, so that there is none experienced in offshore fishing. Only two fishermen expressed any desire to fish outside the reef and their operations were confined to hand-lining just outside the breakers. Since there is no local interest in developing an offshore fishery, it would be impractical to attempt to do so. Nevertheless, the 800 natives on Rota are not now able to obtain a sufficient quantity of protein food, and the most practical form of assistance would be to supply the fishing gear which they were accustomed to use under the Japanese. According to a report from the native commissioners of the two villages, their most urgent need is twine from which they can knit throw nets. They formerly had one to a family, but at present there are only eight left altogether. These nets were approximately 10 feet in diameter. An ample supply of twine for making throw nets should be kept on the island. Canoes or other small boats are not essential as few woulduse them, nor are hooks or lines especially needed. In the absense of throw nets, the natives do a small amount of spear fishing with goggles on the reefs, and women and children collect shell fish--mostly trochus, cat-eye, and spiny lobsters--from the reef. Outside of these the natives have a few chickens, and sometimes coconut crabs and fruit bats. Occasionally a deer is taken. According to the native commissioners, they were accustomed to having fish at least once a day and estimated that they used approximately a pound of fish per person. However, due to the lack of cast nets and nonavailability of fresh fish from the offshore fishery, they obtained fish only two or three times a week. The fish is mostly prepared by roasting, boiling with vinegar, or eaten raw.

A favorite method of cooking fish throughout the Marianas is to fry them in coconut oil. This was also done on Rota, but at the present time, the destruction of coconut trees has been so great that no oil is produced locally and none has been imported.

Sea cucumbers are not eaten and shark meat also is not used by the native population.

Barringtonia nuts are occasionally ground into a paste and used as a fish poison. Derris root, also, is sometimes used, although rarely.

During May and June large schools of a small silvery fish, two to three inches long, called manahag, believed to be young herring, are taken in large quantities by throw nets and are salted down for future use. These large schools appear annually, both at Rota and Guam, and stay only a few weeks.

Important in the diet are animals from trochus and cat-eye shells. These are mostly caught by women and children while wading on the reefs at low tide during the day. Spiny lobsters are also used in large quantity, but are caught by men and boys at night by torching. They use a three-pronged spear without barbs on the points. The torch was not observed elsewhere. It consists of a section of bamboo approximately four feet long and two to three inches in diameter. One end is open and the internodal space is stuffed with rags soaked in kerosene. The kerosene capacity is sufficient to burn for two to three hours.

A specialized type of net was developed in the Marianas for gill netting at night. In order to prevent phosphorescence in the water from showing the position of the net and frightening away the fish, the netting and floats were dipped in pig's blood. Instead of ordinary leads to hold the net down, the tops were cut off of one of the cypraea shells (C. caputserpentis), which were then tied to the lead line at intervals of 15 to 18 inches. The net was a mile in length, six feet deep, with a one inch square mesh. The floats were of pago wood and were eight to ten inches by two inches in diameter.

D. GUAM ISLAND (Population 22,783 - 1946)
(June 19-27)

The fisheries of Guam are under the jurisdiction of the agricultural division of Military Government. In order to encourage production of sea foods several steps were undertaken. One was to remove ceiling prices from seafoods. A second was to designate certain men in each village as fishermen thus relieving them of other employment. A third was to give exclusive trap fishing rights along certain areas of the coast to single individuals. Finally, several vessels belonging to Military Government were offered on a rental basis to fishermen with the hope of stimulating production of off-shore species, such as bonito. These measures have been largely unsuccessful. Removing ceiling prices can be effective only in cases where production is sufficient to increase income appreciably. The general shortage of manpower on Guam has made it more profitable for wage earners to work for the armed services rather than to go fishing. Consequently very few of the men designated as village fishermen are actually so employed. Examination of the traps in the vicinity of Merizo show a catch of only a few pounds per day, entirely insufficient to warrant this type of fishing as a primary source of income. The rental of fishing vessels has not resulted in the development of off-shore fishing for a number of reasons. In the first place, there is no back log of experienced fishermen to undertake this type of work. In the second place, shore facilities are not available in the event of a large catch. In particular, it is necessary to have ample refrigeration space to handle the catch. It is also necessary to have transportation facilities in order to distribute the catch to consumers. Very few fishermen can afford to pay a thousand dollars for a surplus weapons carrier or similar type of vehicle.

The limited reef and inshore areas are not sufficiently large to warrant any expectation of an increased catch from this area. In the case of an off-shore fishery for tuna and bonito it seems probable that it would be necessary to bring in experienced fishing crews from other islands, such as Saipan, and to subsidize them heavily over a period of possibly six months by furnishing vessels, equipment and refrigeration space at no cost in order to develop the fishery. Unfortunately, one of the limiting factors in the establishment of an off-shore fishery for tuna and bonito is the availability of live bait. Our limited observations can throw no conclusive light on the abundance of bait fish around Guam and if a successful off-shore fishery is to be established, a thorough investigation must be made of this supply. However, our impression is that there is not an ample supply of bait fish around Guam which would warrant the encouragement of a large off-shore fishery.

The most common type of fishing gear is the throw net. The usual size is seven feet in length and there are two common sizes of mesh, one of 1/2 inch bar or one inch stretch mesh and the other about half that size, approximately 1/4 inch bar of 1/2 inch stretched

mesh. Both are made of cotton twine. Diving and spearing of fish are negligible. There are quite a number of small seines which are used in multiples of 30 feet by tying sections together. These seines are straight, about three feet deep and of one inch stretched mesh of cotton twine. There are only a few scattered places where seines can be used because of the rough bottom. Spiny lobsters are fairly abundant and a good many are taken at night by torching. Octopi are also very common up to three feet in total spread. Both the spiny lobster and the octopus are regarded very highly as food by the Guamanians and they also eat the small black tipped sand shark (Eulamia melanopterus).

Although there are a few small outrigger canoes 12 to 14 feet in length, these are very roughly constructed and have relatively little carrying capacity. The Guamanians prefer United States manufactured small boats, both power and sail.

The most promising locality for increasing production is at Umatac. There are a number of good fishermen here who are experienced in going off-shore and who have in the past operated gill nets for mackerel with good success. It is reported that their catch amounted to 40 to 50 thousand pounds of mackerel a week during the season. Here again increased production would be dependent on establishing refrigeration and transportation facilities.

Because of its partial isolation there are more fish around Cocos Island than around the shore of Guam itself. On the lee side of the island there were schools of large mullet 14 to 16 inches long, large crevalle of 10 to 15 pounds and blue wrasse (Cheilinus sp.) (Fig. 36) up to 30 pounds were observed on the seaward side. Goat-fish up to ten inches in length also were common. For further recommendations concerning fisheries on Guam, see Part III Summary and Recommendations (IV D).

Fig. 36... Guam. Blue wrasse (Cheilinus undulatus), taken with surround net. June 1946.

PART II DESCRIPTION OF THE FISHERIES

INTRODUCTION

Although the number of economic species of fish, reptiles, and marine invertebrates is certainly in excess of 2,000, the day to day subsistence of the Native people is dependent on a comparatively few groups. Of the reef and inshore fish it will be found that throughout the mandated area the most important are the angel fish, the barracuda, the crevalle, the wrasse, the goat-fish, the parrot fish, the squirrel fish, and the surgeon fish. Among invertebrates, the more important ones are a type of cockle called anadara, conch, crab, octopi, the rock oyster, spiny lobster, giant clam, trochus, and turbo or cat-eye. Although a number of species of sea cucumbers are abundantly distributed over the entire area, they were not found to be an important item in the native diet.

On the various kinds of fish found in the open ocean outside the barrier reefs, the tuna, mackerel, and sword fish are of general importance. A few of these offshore fish are taken by the natives, usually by trolling just outside the breakers on the barrier reef. The natives fish depths of as much as 20 fathoms, where they sometimes take swordfish weighing over 200 pounds, and yellow fin tuna weighing up to 80 pounds.

Occasionally a dugong or sea cow was taken, particularly in the Palaus, but the total number evidently never amounted to more than a few a year.

The failure of the natives to develop more of an offshore fishery was not due to their inability to catch the tuna and other species, but simply resulted from the fact that they had no need to. From a practical standpoint it was easier for them to obtain their fish from the constant fish population on the reefs and in the lagoons. Their offshore fishing was more in the nature of what we would call "sport fishing". The taking of an extra large tuna or swordfish is described by the natives with as much enthusiasm as though it were to be entered into the records of the International Game Fish Association.

Since fishing between the shore and the reef provided most of the food for the table, there was a customary division of labor between the sexes. Usually women and girls fished the reefs and flats close inshore, which are either exposed at low tide or nearly so. The men did the spear fishing, diving, and hand-lining, either around the reefs or in favorable spots in the lagoons. Boys begin going fishing with their fathers when about six years of age, and by the time they are ten they frequently go fishing with groups of others of their own age. Fishing with beach seine or from canoes is usually entirely in the hands of men. The women either collect their fish by hand or, in some cases, use a small hand net to collect small fish around rocks in the shallow waters of the flats. Most of the diving done by the men is in less than four fathoms.

The above statements should not be construed to mean that the fishery resources of the former Japanese Mandate are only sufficient for native subsistence. Succeeding sections will show that the Japanese actually took 75 million pounds of bonito from the area in one year, using shore based fleets of small fishing vessels under 50 tons. In addition, several factory ships produced an unknown, but certainly sizeable quantity which did not appear in the Mandate statistics. There is no doubt that offshore supplies of bonito and tuna are ample to support a fishery approaching 200 million pounds annually.

The present state of our knowledge of the tunas does not answer the question of whether or not the tunas of the mandated area are seasonally a part of the population which supports the Japanese home fishery, and if so to what extent. If this should be the case, it is possible that a catch of 200 million pounds in the former Mandate would cause some reduction in catch off Japan proper.

I. BONITO INDUSTRY

A. STATISTICE OF THE BONITO FISHERY

Maximum production of bonito was reached 1937 (Table I) with a catch of 74,983,780 pounds valued at $958,476 (¥4.00 to $1.00), or 1.3 cents per pound average to the fishermen. The price of fresh bonito varied from place to place (Table 2), and fluctuated according to local abundance, but basically it was a percentage of the market price for bonito sticks in Japan. The 1937 price of fresh bonito was 9 percent of the market price of bonito sticks in Tokyo. The local price in the Palaus, for example, was established monthly, calculated at 9 percent of the price which Palauan bonito sticks sold for in Tokyo the preceding month.

In 1938 the catch dropped to 32,703,981 pounds, and to 25,411,466 pounds in 1941. This the last year for which statistics are available from the South Seas Government records, but it is known that the catch declined abruptly in subsequent years.

The extra heavy catch in 1937 seems to have resulted from the operations of an unusually large number of fishing vessels, some of which were withdrawn the following year. Table 4 lists the number of fishing vessels at bases in the mandated area in 1937. Figures for the following years are not available, but the number is known to be less.

Japanese recommendations are that the number of vessels in the bonito fishery should be 25 at Koror in the Palaus; 20 at Truk; and 10 at Ponape. In addition, 40 vessels of 50 to 60 tons could be used for tuna, 20 each at Koror and Truk.

Table 5, from South Seas Government figures for 1941, shows the production from the more important marine fisheries at centers in the Mandated Islands. In the case of white pearl shells (Gold-lip pearl oyster), it is believed that most of the catch was taken in the Arafura Sea. In using this table, note that bonito and tuna sticks are processed from the fresh fish, consequently the vertical column totals for weight are incorrect. Also, the figures for shark fin production in the Palaus are confusing. It is obvious that 42,858 kg of sharks would not yield anything like 22,028 kg of fins. Quite probably fins were removed from captured sharks, and the carcasses discarded. This, however, is mere speculation. In any event, the figures are the only ones available for the last pre-war year, and are sufficiently valuable to be included in this report.

No figures could be found on the extent of the canning industry. The only information is that the Palau cannery at Koror, with a capacity of 500 cases a day, was completed in 1939, and operated at capacity for a short time in 1940. It packed tuna in oil, and was the only operating cannery on a commercial scale in the Mandated Islands.

TABLE 1

Bonito Catch -- Japanese Mandated Islands 1934-1941
Catch in Millions of Pounds, 000 omitted [1]

PLACE	1934	1935	1936	1937	1938	1939	1940	1941
SAIPAN	5,535	3,929	3,721	8,134	5,702	4,591	Data	2,854
YAP	9	....[2]	....	....	123	79	not	12
PALAU	8,313	11,860	8,439	30,304	11,924	12,207	available	7,277
TRUK	2,639	6,605	12,914	27,353	11,648	16,807	____	9,561
PONAPE	2,645	2,888	5,930	8,940	3,290	8,157	____	5,333
JALUIT	561	505	369	200	14,770	....	____	372
TOTALS	19,702	25,787	31,373	74,931	32,701	41,841	____	25,409

[1] Original data given in kilograms. Conversion to pounds x 2.2.

[2] No commercial production at Yap, 1935-1939, incl.

TABLE 2

Prices of Fresh Bonito -- Dockside
Cents Per Pound

	1934	1937	1941
Saipan	02.5	01.25	03.25
Yap	03.5	N.A. [1]	N.A. [1]
Palau	03	01.25	02.5
Truk	03.75	0.75	02.5
Ponape	02.5	01.25	02.5
Jaluit	02.5	01.25	07.5

[1] N.A. -- Not Available

TABLE 3

Weight Relation of Bonito Sticks To Fresh Bonito

	Fresh Bonito	Bonito Sticks	%
1936	14,265,772	2,422,856	17.
1937	34,060,809	5,812,745	17.
1938	14,958,592	2,501,222	17.
1941	11,545,053	1,333,840	11.6 [1]

[1] Authors note: This low figure may be due in part to increased use of fresh bonito to feed augmented garrisons of Japanese troops.

TABLE 4

Number of Fishing Vessels in the Mandated Islands, 1937

Port	Below 20 tons	Above 20 tons	Total	No. Crew
Saipan	34	3	37	630
Yap	4	—	4	96
Palau	89	160	249	3154
Truk	47	3	50	817
Ponape	18	1	19	586
Jaluit	1	-	1	21
TOTAL	193	167	360	5304

TABLE 5

1941 Catch And Production — Mandated Islands (From South Seas Government)

Weight In Kilograms — Value In Yen
2.2 pounds 4 yen to a dollar

		SAIPAN	YAP	PALAUS	TRUK	PONAPE	JALUIT	TOTAL
Bonito Fresh	KG	1,297,354		3,308,160	4,346,259	2,424,260	169,020	11,545,053
	¥	358,996		827,040	1,118,166	509,094	105,638	2,918,934
Bonito Sticks	KG	182,152		370,290	724,800	332,266	24,332	1,333,840
	¥	491,227		907,210	2,011,718	774,384	65,895	4,250,434
Tuna Fresh	KG	33,669		906,150	24,150	12,768	46,356	1,023,093
	¥	19,913		253,722	5,847	9,150	27,073	315,705
Tuna Sticks	KG			54,533	3,956	2,730	5,500	66,719
	¥			97,069	11,373	6,552	14,888	129,882
Horse Mackerel	KG	4,014	1,896	1,613	7,559	14,830		29,932
	¥	2,302	1,251	1,290	4,031	7,425		16,299
King Mackerel	KG	5,767		14,092				
	¥	3,356		11,555				
Mullet	KG	75				6,075		6,150
	¥	40				3,037		3,077
Sharks	KG	10,705		42,858		2,665		56,228
	¥	3,012		214		527		3,753

TABLE 5 (Continued)

1941 Catch And Production -- Mandated Islands (From South Seas Government)

Weight In Kilograms — Value In Yen
2.2 pounds 4 yen to a dollar

		SAIPAN	YAP	PALAUS	TRUK	PONAPE	JALUIT	TOTAL
Shark	KG	150		22,028				22,178
Fins	¥	500		44,056				44,556
Other	KG	288,688	46,742	334,877	56,419	134,973	26,724	828,405
Fish	¥	105,033	24,779	174,137	22,765	67,486	13,362	407,556
Trochus	KG		21,080	[1]	48,835			69,875
Shells	¥		2,524		6,479			9,003
White	KG			212,688 [2]				212,688
Pearl Shell	¥			183,430				183,430
Black	KG			559				559
Pearl Shell	¥			50				50
Sea Cucumbers	KG	2,117	3,136	9,556	14,486	9,172		38,477
(Trepang)	¥	4,437	4,892	12,723	22,227	15,317		59,596
Coral	KG			18,236				18,236
	¥			261,305				261,305
Other	KG	53,555		206,875	135,131	12,075		407,576
Shells	¥	12,179		35,758	30,269	2,415		80,621
TOTALS	KG	1,878,236	72,854	5,502,515	5,361,595	2,951,814	271,932	
	¥	1,000,995	33,446	2,809,559	3,232,875	1,395,387	226,856	8,699,118

1 No open season for trochus in Palaus, 1941 (So stated in Japanese report)
2 Pearling fleet based at Koror, but shells taken elsewhere (Author's note)

Figure 37. Truk. Japanese Fishing Sampan.

Figure 38... Saipan. Bonito Fishing No. 1.
Laying out live-bait net. June 1946.

Figure 39... Saipan. Bonito Fishing No. 2.
Driving live-bait into net. June 1946.

B. THE JAPANESE BONITO FISHERY

The length of time required to establish a new fishery is well illustrated by Japanese experience in attempting to exploit the bonito in the former Mandated Islands. Although they were in control from 1914 on, it was not until the middle twenties that sufficient information had been gathered to indicate the possibilities of a large fishery. Their first attempts were made in the vicinity of Saipan, but because of the shortage of live bait the results were not encouraging. Further search showed that a much greater supply existed in the Palaus and special attention was given to this area.

In the late 1920's bait fish were also found at Truk and development here was started. Realizing that some form of subsidy would be required to get commercial production started, the Japanese Ministry of Agriculture and Commerce offered special inducements to Okinawan fishermen who would migrate to the new centers. These inducements were in the nature of cash awards for the construction and outfitting of fishing vessels and for shore installations. As production increased and the fishery got on a more stable oasis, a number of fishermen organized cooperative fishery companies, while others operated their own vessels independently. By the early 1930's operations had been extended from the original localities around Palau and Truk to Ponape and, to a lesser extent, to Yap and Kusaie. Because of the long distances involved (approximately two thousand miles from Tokyo to the Palaus), the catch was processed for export in the form of dried bonito sticks. It is interesting to note that producers of this item in the Japanese homeland were not pleased to have competition from a new direction and at first adopted customary methods of attempting to freeze out competitive products.

The method of fishing now in use at Saipan is described below. It is similar in all respects to the methods developed and used by the Okinawans. The latter sometimes obtained their live bait in a different manner. Apparently the Okinawans were extremely hardy fishermen, for, as soon as their catch was unloaded, they immediately refueled and left to catch live bait during the night. Schools of bait fish were attracted by lights and when a large school had been assembled it was led, by moving the light, to the bait net. At daylight the necessary quantity of live bait was put into the ship's tanks, the balance remaining in the bait net until needed. The vessel then started hunting for bonito and fishing began as soon as a school of fish could be brought alongside. Ordinarily the Okinawans did not stay out overnight, even if no fish were caught.

C. NATIVE BONITO FISHERY ON SAIPAN
(June, 1946)

In addition to two sampans, (Fig. 37) the facilities on Saipan consist of a dock capable of handling three or four sampans and a shed where weighing, washing, and gutting can be carried on. These sampans were owned by, and the operations are carried out under, Military Government. The fishermen were paid only the regular daily wage established by Military Government and the fish were distributed free to the native population. In view of the high degree of skill shown by the native fishermen, it is believed that the fishery could be placed entirely in their hands to be operated on a cooperative basis and the fish sold. It is recommended that the vessels and their equipment either be given to the natives, or appraised at only a nominal value of around $500.00 each.

It must be remembered that these Japanese sampans were sunk at Saipan and were subsequently re-floated and repaired. It should not be expected that the natives would bear the cost of salvage and repair. Since the dock and shore facilities are essential to the fishing operations, and are in a large measure of public benefit, they could be leased to the fishing cooperative at some rental such as $1.00 a year, but in any case a definite guarantee should be given of occupancy for a period of at least five years. Such an arrangement would not only assure to the fishermen a more adequate compensation for their labors, but would also greatly increase, possibly double, the production of the fishery.

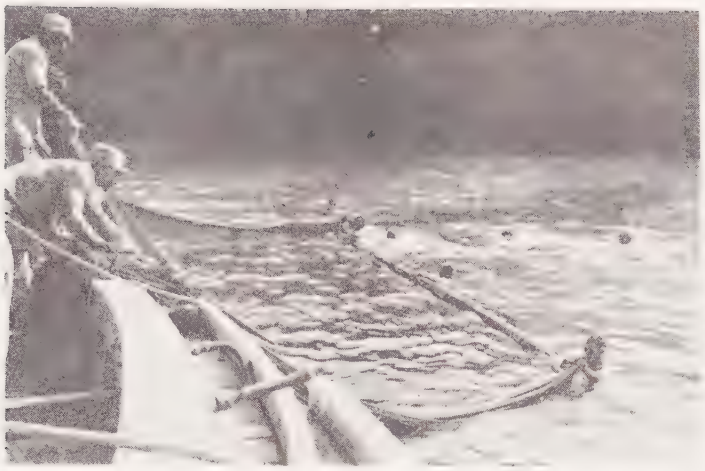


Figure 40... Saipan. Bonito Fishing No. 3.
Drying-up live-bait net.
June 1946.

Figure 41... Saipan. Bonito Fishing No. 4.
Bailing live-bait from net to tanks.
June 1946.

Figure 42... Saipan. Bonito Fishing No. 5.
Detail of live-bait and tanks.
June 1946.

Figure 43... Saipan. Bonito Fishing No. 6.
Salt water sprayer. June 1946.

Figure 44... Saipan. Bonito Fishing No. 7.
Method of fishing. June 1946.

At the time of our survey, refrigeration was not required in the dock area. All except a small portion of the catch was merely weighed, washed, and distributed to the native population in the round. This is a satisfactory arrangement as long as the demand exceeds the supply, since all of the fish immediately go into the consumers' hands and are eaten within twenty-four hours. However, refrigeration facilities should be made readily available to handle any excess of production over immediate consumption.

All of our information leads to the conclusion that the fishery could be considerably increased and that both the supply of bonito and bait fish will stand a considerably larger production. It should be possible, using the present experienced crews as teachers, to interest a larger number of the natives in becoming expert fishermen, with the hope that eventually possibly as many as ten fishing sampans could operate from the docks at Saipan. Since the increased production would not be required to feed the local population, it would be the aim of this expansion to prepare dried bonito for export to Japan or China. Since the method of processing is important in preparing a type of product desired by the Japanese and Chinese, it would be the best policy to bring in from Japan one or more persons experienced in the preparation of dried bonito to teach the natives the Japanese process. The need for technical assistance would probably not extend over a longer period than six months.

The importance of the bonito fishery, not only at Saipan but at other places throughout the former mandated area, warrants a full description of the method of fishing, since it will become a pattern for future operations. The sequence of operations is taken from an actual day of fishing.

Departure from the dock was at 4:00 a.m. and by 5:45 the vessel was standing close inshore along the cliffs of Tinian to search for live bait. As soon as it was light enough to see, the vessel moved slowly along the cliffs and a diver was sent over about every 100 feet until one of them located a school of the small anchovies (Anchoviella purpureus), used for bait. The sampan then took up a position about 100 yards from the school of bait fish and was quickly anchored by bow and stern parallel to shore and less than 100 feet from the cliff. Then two or three lines with a hook at the end were carried ashore by swimmers and fastened to the rocks at water level to hold the ship from drifting away from shore. They were now ready to set the bait net, which is approximately 30 by 60 feet and made of very heavy bobbinet. This net is stretched between the ship and cliffs with one short edge inshore and the other on the ship (Fig. 38). The short edge which is carried ashore is held at the surface by a large bundle of bamboo, which acts as a float. The leading edge of the net which is toward the school of fish is then weighted down at or near the bottom. The trailing edge away from the fish is held at the surface. Ten or twelve fishermen then go over the side and form a semi-circle around the school of fish and by swimming slowly, drive the school into the net (Fig. 39). As soon as the school is within the leading edge of the net, this edge is brought up to the surface, forming a trap. Some of the net is then drawn aboard the ship and some is wrapped around the bamboo float on the shore end until the school of fish is in a small pocket alongside the ship (Fig. 40). From this pocket they are bailed into the two large bait tanks located amidships (Fig. 41). The bait tanks are formed by two watertight bulkheads, which make a watertight compartment in the center of the ship. This compartment is further subdivided to form two tanks (Fig. 42). In this section two-inch holes are bored through the bottom of the hull in the way of the tanks to provide salt water circulation. This circulation is dependent on the motion of the vessel and is only sufficient to keep the bait alive during several hours. It is not enough to keep the bait alive over-night.

On the trip in question, approximately an hour was required to catch a small school of bait fish. The ship then moved offshore and the captain began looking for flocks of sea gulls feeding at the surface, which are used as indicators of schools of bonito below. When a school was located, the captain brought the ship across the head of the school and approximately 100 yards away. The engines were then stopped and small quantities of live

bait were thrown over. As the vessel drifted slowly, the bonito followed the live bait to the stern of the ship. As soon as a school has been brought to the ship there is a definite division of labor among the fishermen and each man has a task to perform. In this case 17 men did the actual fishing. There were four men across the stern and 13 men along the port rail from bow to stern. No fishing was done from the starboard side. One man on the starboard quarter threw live bait over the stern to keep the fish coming to the four men who were fishing there. Amidships on the port side one man threw live bait both fore and aft to keep the fish coming to the fishermen on that side. Two men got bait out of the tanks while two others kept the bait throwers supplied with fresh live bait. Throughout the fishing, salt water is sprayed over the side from nozzles located about every four feet (Fig. 43). In this case there were eleven nozzles operating on the port side and three on the stern. The purpose of this spraying is twofold: first, it tends to prevent the fish from being frightened by sight of the fishermen; and second, the action of the spray on the water is somewhat similar to a school of small bait trying to escape. Each fisherman has a heavy bamboo pole about ten feet in length to which is attached a line of the same length. At the end of the line is a barbless hook, which may be one of two types. In one case it has a few white feathers attached to it, similar to a feather jig, and in the other case it is plain and a live minnow is put on the hook by inserting the point through both lips. The feather jig is used when the fish first come alongside the ship and is worked back and forth near the surface. After a few minutes the fish seem to become aware of the fact that the feather jig is not alive and cease striking on it. This jig is then removed and the plain barbless hook is put on with live bait attached through both lips. Fishing continues until the school of bonito sounds or the live bait is exhausted.

The actual catching of the fish requires considerable skill and dexterity. As soon as a fish strikes, the fisherman leans back and down, heaving the fish quickly out of the water and toward the ship (Fig. 44). The amount of power put into lifting the fish is gauged carefully so that the fish will come aboardship at about the height of the fisherman's waist. He grabs the fish under his left arm, removes the hook (if it has not already come out of its own accord), and in practically one motion throws the fish behind him on deck and drops the hook again into the water. Some of the fishermen are so skillful that they can with one heave bring the fish up and on deck, disengage the hook without touching the fish, and be fishing again while the fish is flapping on the deck. Expert fishermen will catch from ten to twelve fish per minute. All of the fish caught were ocean bonito or skipjack (Katsuwonus (Euthynnus) pelamis), and 4,017 pounds were taken in an hour and five minutes. The average weight per fish was nine and a half pounds.

In addition to the bonito there are heavy runs of mackerel, particularly during the month of March. In March of 1946 large schools came inside the reef, and during one week a total of 68,000 pounds were taken. If facilities were available, it is reasonable to expect that several hundred thousand pounds could be taken annually.

It must be remembered that here, as elsewhere, the Japanese did not allow the Chamorros to go outside the reef and consequently they were unfamiliar with offshore fishing methods. Their progress in becoming expert fishermen since the American occupation has been most encouraging. With proper support there is every reason to expect that they can develop a very flourishing fishery for bonito (skipjack), tuna, and mackerel.

It is suggested that it might be worthwhile to undertake experiments with some type of purse seine or lampara net for the taking of bonito. It is realized that there are many difficulties involved, especially the rapidity with which the schools of fish travel, the transparency of the water, and the fact that there is no smooth bottom in shallow water. Quite possibly the operations would have to be carried on at night. Such a method would, however, make possible the establishment of fisheries in areas where bait fish are not abundant. Recognizing the limitations imposed by the supply of bait fish, the Japanese experimented with purse seines during the 1920's but were unsuccessful in developing a suitable method.

It might also be possible to extend fishing operations to new localities by developing the methods of obtaining sufficient supplies of other types of live bait than the anchovy, which is the mainstay of the industry in the Palaus and at Saipan, small goat-fish should be especially good for this purpose.

There are several recommendations in regard to bonito fishing. First, it is believed that the sampans could be operated efficiently with a crew of 14 to 16 men instead of the 26 to 28 now used, thus providing an extra crew for an additional boat. Second, if it is found necessary, the sampans should be allowed to remain out overnight when they have found no fish during the day.

This would permit them to replenish their bait supply before dark so that they could begin searching for fish at dawn the following day, it being well known that the best fishing time is early morning. This would serve the additional purpose of getting the catch back to the dock in a fresher condition, as they would be caught during the coolest part of the day. Consideration should also be given to the desirability of the sampans carrying at least half a ton of ice for the preservation of the catch which is made earlier in the day, especially since in many cases it is the middle of the afternoon before the boats return from fishing. A half ton of ice would be sufficient to preserve up to 1,000 pounds of fish for twenty-four hours if the hold is properly insulated.

D. DRIED BONITO STICKS--JAPANESE METHOD

The bonito sticks, as prepared originally in Japan and subsequently in some of the former mandated areas have many advantages. Chief among them is durability. When the process is finally completed, the sticks may be kept without refrigeration for months. Packaging is simple, as it is only necessary to wrap the individual sticks in paper and ship them in wooden boxes or barrels. The process is a simple one and requires only facilities for cooking, although, in order to take advantage of large runs of fish, some type of refrigeration is essential. It takes about two weeks to finish the various steps involved.

A number of women were employed in butchering, skinning, scraping, trimming, and packing. In some cases they were paid a flat monthly wage, of around ¥40 to ¥60, but ordinarily they were paid a basic wage, plus a bonus for piece work. In addition to their salaries, they obtained discarded parts of the fresh fish for their own use. Native women were employed as well as Japanese and Okinawans. Native men were not commonly employed.

From the fishing vessels the bonito are brought in to the butchering tables, where the head is cut off and the guts removed. Gutting is generally accomplished by cutting off the entire abdominal section of the fish. Two fillets are then cut from the backbone and these strips again cut lengthwise, making four pieces from each fish, unless they are quite small, in which case there may be only two pieces; or, if the fish is extra large, they may again be cut across. The strips are then placed in a single layer in steel trays, which are stacked in the boiling kettles. The temperature of the water is below boiling when the fish are put in. Usually it is between 170° and 190° F. It is then slowly raised to boiling point and cooking is continued for about an hour. Cooking is done at as low a temperature as possible to prevent the flesh from splitting. Fresh fish requires somewhat lower temperature than stale fish. When the cooking is completed, the fish are allowed to cool slowly and then the skin and small bones are removed and, in order to maintain the original shape of the individual pieces, any cracks in the flesh or broken-off pieces are carefully replaced with a paste of cooked flesh. After these repairs are made the fish are ready for drying.

The ovens were made of brick, six feet in height, of which four feet was underground, and other dimensions convenient to take the drying trays. The latter were of wood with a

bamboo screen across the bottom and were triangular in shape, approximately three feet on two sides, two feet on the third side, with a depth of three inches. Ten of these trays were stacked on top of each other in the oven above a wood fire. The maximum temperature at the top tray was held to approximately 175° F. The strips were dried for only one hour a day and during this period the trays were interchanged in position so as to give even temperatures from top to bottom. Altogether, from 10 to 15 heatings were necessary. The purpose of this slow drying was to prevent the outer flesh from drying while the inner parts still contained large amounts of moisture.

After the sticks are thoroughly dry they are carefully scraped in order to bring them all to a uniform size and shape. The next step is to allow the sticks to mildew. They are packed in wooden boxes holding approximately 70 pounds, covered, sealed, and stored in a warm room for about two weeks. When the green mold has developed over the entire surface of the sticks they are removed from the warm room and dried in the sun. This treatment removes the fat which otherwise by decomposition would give a bad flavor and taste to the meat. After removal from the warm room and sun drying the sticks are brushed, repacked in boxes, and placed in a sterilization room where carbon bisulfide is evaporated and also steam sterilization is used. Following this, the mildew process is repeated twice and between treatments sterilization is given. After the final sterilization the sticks are packed 70 pounds to a box for shipment to Japan.

II. THE JAPANESE TUNA FISHERY

Although the natives had occasionally taken tuna and comparatively large supplies were known to be present, the Japanese did not develop the tuna fishing until around 1940. Probably the reason for this delay was due to the need for larger and better equipped vessels and additional facilities ashore, particularly refrigeration. The establishment of a cannery in the Palaus did much to stimulate this industry. Experienced tuna fishermen from Japan with vessels ranging in size up to 60 net tons were just getting into production at the beginning of the war. The Palau cannery had a capacity of 500 cases per day, but it is doubtful if it operated at capacity for more than a short period in 1940. There was also limited production at Truk. In contrast to the bonito fishery, where pole fishing was employed, the tuna industry was based solely on long line fishing. The depth at which the lines were fished and the total number of hooks which could be handled from each vessel, are unknown. Information obtained at Truk was to the effect that tuna vessels were frequently away from port two weeks or more, but the exact location of the areas fished was not determined. Although tuna production was only in the neighborhood of two million pounds in 1941, there is every reason to believe that this industry would have expanded rapidly and perhaps reached as high a level as that for bonito in the course of another four or five years.

III. SPONGE CULTURE

A. NATIVE SPONGES

Native sponges of several types (yet unidentified) occur throughout the former mandated area. At Ponape, Kusaie, and Likiep, they are abundant enough to be used commonly in place of a towel after bathing, and for scouring cooking utensils.

They occur in depths less than two fathoms, but no investigation was possible to determine if there were additional resources at greater depths.

Since sponging was not a separate industry, the supply was obtained by fishermen who found them while engaged in regular fishing activities. They were pulled by hand, no special implements being used. In preparing them for use, the only treatment was to let the flesh rot in sea or fresh water for several days, then wash thoroughly in fresh water and dry.

Figure 45...
Ailinglaplap.
Anchor and float for sponge culture.
August 1946.

B. JAPANESE SPONGE CULTURE AT AILINGLAPLAP (Marshalls)

On 26 August, 1946, an examination was made of the experimental sponge beds planted at Ailinglaplap by the Japanese in June and July of both 1939 and 1940. The planted area covers approximately two acres located just west of South Passage channel on the lagoon side. Depth is three to five fathoms with a white coral sand bottom. The area is well protected from rough water on the east by the channel reef, which is exposed at low tide. There are also protective reefs on the north and partly on the west. On the south, Bigatyelang Island prevents high winds from reaching the area.

The method of planting was very simple and was done by natives under Japanese supervision. Cement blocks 5 by 5 by 2 inches were used as anchors. From this block a piece of solid aluminum wire, about #12, stretched upward to a float made of a tightly corked and sealed Japanese one liter beer bottle (Fig. 45). The length of the wire varied somewhat depending on the depth, but was long enough so that 24 sponge cuttings could be strung on it four inches apart. A few wires had as many as 30 sponges on them. Not all of the cuttings survived, but mortality was not excessive, for almost all wires had 20 to 24 sponges on them. The bottle float was from a fathom and a half to two fathoms below the surface. The lowest sponge was 12 to 18 inches above the bottom. Anchors were spaced 10 feet apart on the bottom, sufficient to prevent fouling the wires in case of a storm, for we saw no wires which had become tangled.

According to a native informant, samples were sent to Japan, but no commercial harvest was made. The best time for taking up as well as planting is June and July, as that is the season of least wind and calmest water. A few sponges are taken by natives for washing babies. Their method of cleaning sponges is to bury them under water and sand on the lagoon reef for three days, then wash them in salt water followed with fresh (rain) water, then dry them in the sun.

Although it was impossible to make an exact count, there are several hundred sponges remaining. The aluminum wire is becoming brittle, and unless the sponges are either removed or restrung, it will not be more than another six months until some become detached. Because of the fine sand bottom, it is probable that sponges falling to the bottom would be silted over and killed by the first heavy wind.

The sponges are a very dark blue color when alive, but after cleaning are very nearly white without bleaching. The size varied from four to six and a half inches in largest dimension. Shape was rather irregular, almost all individuals having one or more short

protruberances which prevented them from having a circular shape. It is not known what shape or size cuttings were planted, but growth seems to have been relatively slow, less than an inch a year.

Ownership of the sponges is in doubt. The native Chief claims them as his property, but Military Government officers have ordered that none be harvested until notified.

All of the sponges are of the same species. A small sample was supplied to Dr. Lewis Radcliffe, Executive Secretary of The Sponge Institute, Washington, who sent one to Dr. M. W. deLaubenfels for identification. Dr. deLaubenfels reported as follows:

"The specimen is Spongia officinalis, subspecies mollissima, known as Fine Levant or Turkey Solid. One expects to find this exclusively in the eastern Mediterranean, and it is absent or rare elsewhere in the world. The specimen is one of the finest I have ever seen. Its fibers are a little bit weak, perhaps as a result of chemical bleaching, but in general it is worthy of enthusiasm."

Additional specimens will be sent Dr. deLaubenfels for checking. The weak fibers were not due to chemical bleaching, and it may be that this is due to differences in Mediterranean and Central Pacific conditions. In any event, it is evident that sponge culture has definite possibilities, and the sponges now at Ailinglapalap should be used mainly as cuttings to extend planting to other suitable places.

IV. PEARL SHELLS

A. DISTRIBUTION OF PEARL OYSTERS

The black lip pearl oyster (Pinctada margaratifera) is widely distributed throughout the former mandated area. Specimens were taken at Saipan, the Palaus, Ponape, Kapingamarangi, Nukuoro, and Likiep. They occur in abundance only in the Palaus. The Japanese figures for 1941 showed a production from the Palaus of approximately 2,500 tons, but an unknown percentage of these may have been taken in the Arafura Sea. It is believed that limited commercial production would be possible at Truk and Ponape and it would be well worthwhile to attempt increasing the abundance in a number of localities such as Kusaie, Kapingamarangi, Ailinglapalap, Majuro, and Eniwetok.

No specimens of the gold lip pearl oyster (Pinctada maxima) were seen at any place visited. However, it is known that the Japanese brought in some of this species to Palau for their experiments in pearl culture and it is quite likely that more thorough investigation would reveal some in the near vicinity of Koror.

Following the success of Mikimoto in commercializing the culture of pearls in Japan, numerous attempts were made to establish this industry in the former mandated area and also in the Philippines and the Dutch East Indies. The main experiments were carried on in the Palaus, where plantings were made as early as 1930 and at the time the war began four companies were engaged there in pearl culture. There was also a planting on a smaller scale at Ebon in the Marshall Islands. The work at both of these localities is described more in detail below. The actual number of pearls produced and their quality, either in the Palaus or at Ebon, is unknown to us. For one thing, it was not customary to ship the pearls back to Japan annually. They were exported whenever what they thought to be a sufficient number had been collected. Japanese statistics show 17,783 pearls exported from the Palaus in 1941. However, these could have been produced in previous years as well as 1941.

The great advantage of culturing pearls in the Palaus and other islands of the former Japanese Mandate was the presence there of the larger species of pearl oyster, especially the black lip pearl oyster (Pinctada margaratifera), and the availability of the gold lip oyster (Pinctada maxima). Because of their large size they were not only easier to use as hosts for the mother of pearl blanks, but also the nacre was laid down at a more rapid rate, so that pearls could be produced in two years rather than the three to five which were required for the smaller native Japanese species of the pearl oyster (Pinctada martensi).

B. JAPANESE PEARL CULTURE AT EBON

Although we did not visit the island of Ebon, a native from that island was interviewed at Majuro in regard to experimental productions of culture pearls carried on by the Japanese. This native assisted the Japanese in their planting operations and was one of only three natives permitted to do so. The work was carried on from 1935 to 1942. Three species of oysters were planted: the first was the black lip (Pinctada margaritifera) of approximately six inches in diameter, brought from Namorik; the second species, was the gold lip (Pinctada maxima), approximately six inches in diameter or larger, which was brought from New Guinea; and the third a small white oyster, approximately three inches in diameter, which was brought from Japan. Planting was done inside the lagoon in depths of 3 to 12 fathoms. As at Koror in the Palaus, oysters were placed in wire baskets holding from 6 to 18 oysters each. Some baskets were placed on the bottom, others suspended by wood floats and gasoline drums at varying distances from the bottom to approximately three feet below the surface of the water. The effect of various locations was not known to our informant. He was told that in Japan it took five years to produce cultured pearls, but only three years at Ebon. The informant also did not know which species of oyster proved best for pearl culture. Pearl shell slugs of graduated sizes were put into oysters to form the pearls, as was done at Koror. None of the natives was permitted to watch the process of inserting the pearl slug into the oysters. The Japanese told the natives that it would cost them 1,000 yen to watch the process. Our informant thought that the Japanese must have planted thousands of these oysters. Three Japanese were engaged in this work, and the man in charge was Kosuka Kyoshi. The operating company was the Marshalls Sinsyu Kabushiki Kaisha of Tokyo and Maiken. The plantings were abandoned in 1942, and the informant did not know the present status of the plantings, but thinks it probable (with which I agree) that the natives took up most of the baskets to get the pearls.

V. SEA CUCUMBERS (TREPANG)

Approximately a dozen species (not yet identified) are very abundant throughout the area. The commercial types are shown in Fig. 31. When dried they are known as trepang or beche-de-mer, and are a prized addition to the diet of many Orientals.

A small (4-6 inches) smooth, black species occurs in tremendous quantities on the flats, just offshore in 6 to 12 inches of water. It is sometimes difficult to walk there without stepping on them. Most of the larger species are to be found in deeper water, down to several fathoms, and usually are to be seen in greater abundance at night.

Chief centers of trepang production were Saipan, Palaus, Yap, Truk, and Ponape. This was due, not only to the local abundance of sea cucumbers, but also to the availability of shipping. Trepang cannot be kept indefinitely without protection against spoilage, and remote islands and atolls do not have frequent trading vessels to take a semi-perishable product.

According to Japanese reports, overfishing had reduced the numbers in many places, as no conservation regulations applied to these animals. Our own observations tended to confirm the Japanese statements, as the larger and more desirable commercial species were not very abundant compared with the unutilized species. No information is available on the numbers spawned, or rates of survival or growth. The limited amount of trepang fishing now (summer, 1946) done by the natives gives no indication of the probable need for protection. However, trepang is a cash crop to the natives, and sufficient information should be obtained to protect their interests.

Japanese figures on export of dried sea cucumbers where between 20 to 30 tons per year. Their 1941 figures of production, presumably net weight, were as follows (weight in pounds):

Saipan	Yap	Palau	Truk	Ponape	Total
119,673	68,952	341,244	1,142,779	201,784	1,874,432

At truk, Ponape, and Palaus fishing for sea cucumbers was done by men, as the valuable and large specimens had to be taken mostly by diving, in which the women did not engage. (See also VIIB Trepang Fishing of Truk.)

Figure 46 (Above)
Truk.
Native produced Trepang
(dried sea-cucumber).

Figure 47 (Right)
Truk.
Trochus Shells.
May 1946.

VI. FISHERIES - TROCHUS SHELLS

Several species of trochus are found throughout the former mandated area, but the commercial species, Trochus niloticus, was originally taken only in the Palaus and at Yap. Under the direction of the South Seas Government transplantings of this trochus were made from the Palaus to a number of other localities. The latest transplantings were around 1936. Most of these transplantings seem to have been successful since at present the animals are found in commercial abundance at Saipan, Truk, Ponape, Kuop, Jaluit, Ailinglapalap, and Kapingamarangi.

Trochus are found chiefly on the outside edge of the barrier or fringing reefs at depths to two fathoms. It is stated that they prefer areas where seaweed is present. The collection of trochus shells was given over to the natives. The Japanese bought them for from 10 to 15 sen (¥.10 - ¥.15) each and the total production was sent back to Japan for the making of pearl buttons. Such statistics as are available seem to show that approximately 125 tons were taken per year. However, since considerable planting was done in 1936, and it requires several years for the trochus to become established, there was no harvesting from Saipan, Ailinglapalap, or Kapingamarangi. In addition, the exigencies of war prevented harvesting at any point from 1942 to 1946. In the latter year only a limited amount of harvesting was done under the direction of the U. S. Commercial Company at Yap, Saipan, the Palaus, Truk, and Ponape. There is every reason to expect that during the next few years the production of trochus should amount to as much as 50 percent higher than the tonnage taken by the Japanese prior to the war. However, this will depend to a large extent on the number of shells rejected. (See also VIIC Trochus Shell Fishery of Truk.)

VII. FISHERIES OF TRUK

A. INFORMATION ON PREWAR FISHERY

The following information was secured from Chief Artie Moses who is Chief of the whole Truk Group and owner of Kuop Atoll. He stated that the Japanese brought in the commercial trochus shell from the Palaus and planted them around the reefs at Truk, beginning 20 years ago. The most recent planting was in 1936. Plantings were apparently fairly widespread and included Kuop Atoll. None was planted at Hall Islands. (Author's note: The native trochus is a small species with a rough shell and seldom gets over two and a half inches in diameter. It has no commercial value.) During the war, especially near the end, many trochus shells were taken by the Japanese and by the natives for food. The natives were not allowed to have trochus in their possession before the war as the taking of them was strictly controlled and done by Okinawan divers for the Japanese. There were a few Japanese divers also.

The natives formerly had five and six man canoes both paddling and sailing. These were taken away by the Japanese and the natives were forbidden to go outside the passes. Before the war the natives did a little trolling for bonito with feather jigs outside the reefs, but only for subsistence. They were not employed by the Japanese to get fish for the industry. The main fishery was carried on by the Japanese and Okinawans. Five Japanese sampans came into Dublon Island one day with 500 fish each which was considered a good day's fishing. Each sampan carried a crew of 12 men. Sometimes the catch was as low as 100 to 300 fish per day and occasionally a sampan would get 1,000 fish. The fish averaged five to eight pounds each. The Japanese had a large drying shed on Dublon Island for bonito (Katsuwonis pelamis). No canning or salting was done by the Japanese. They had refrigeration sufficient to hold surplus fish over-night in case of a large catch. Bonito

were sold fresh to the natives for ¥3.00 to ¥4.00 each. The heads, backbones and other by-products of the drying industry were sold for three to four sen each. The price depended on size of catch, as the Japanese reduced the price to get rid of a surplus, and raised it when fishing was light. Toward the end of the war when food was scarce fresh bonitos sold as high as ¥100 each.

The natives themselves dried some bonito partly following the Japanese method after cooking and removing the bones. The flesh was dried in the sun. The natives also salted some bonito although salt had to be imported from Japan. The main native centers of drying and salting were on Tol, Uman, and Pis Islands. There are still some Japanese fish hooks used for off-shore fishing but no fishing line and they have lost the art of using local fibres to make lines strong enough for bonito fishing.

Under the Japanese, in order to fish off-shore or for certain other types of fishing, such as turtle and for shell fish, the natives had to go to the nearest Japanese office and get a license. The native told the Japanese where he wanted to fish, what species he expected to take and the season of the year for each species. If approved by the Japanese, a license written on a wood paddle was issued free and was good for three years. Any native found fishing without a license was subject to fine or work on the roads.

Just before the Japanese surrendered they ordered the natives to destroy all Japanese papers, books, and photographs and the only thing the natives were able to retain were their bibles and hymn books. We were unable to locate any Japanese licenses and none is believed to exist now as native houses were searched by the Japanese to be sure that the order was complied with.

B. TREPANG FISHERY AT TRUK

On Dublon Island of the Truk group there is a Korean merchant who, before the war, handled trepang. He is, therefore, familiar with the Japanese requirements, and it is believed that this industry could be revived in the Truk area with considerable profit to the natives. Yellow, black, and brown trepang were abundant and are present the year round. The process itself is a simple one, requires little investment or equipment, and should be easily within the means of any natives who wish to go into it. During the Japanese occupation the natives collected many thousands of pounds of sea cucumbers for making trepang. Specimens range in size from four to 18 inches in length (Fig. 46). Most of the fishing was formerly done at night, using torches made of dry coconut leaves to locate the sea cucumbers on the shallow reefs. Sea cucumbers were apparently found in greatest abundance at Tol Island, but we found them to be comparatively abundant in the vicinity of practically all islands. In preparation, the sea cucumbers are first boiled, then eviscerated, then dried under cover over a fire. In some cases they are simply dried at comparatively low temperature; in other cases they are smoked. About six grades were produced formerly in the Truk area. Yellow specimens were the most sought after. Apparently, small sizes were used, as it was stated that 50 pieces of dried trepang weighed only one kilogram. A kilogram of the dried product was sold for ¥5.00 at Truk, and for ¥8.00 on arrival at Japan. This presumably was the price to the primary producer. We could not get the price to fishermen. The Korean thought he could prepare approximately ten kilograms of dried trepang per week.

C. TROCHUS SHELL FISHERY AT TRUK (Fig. 47)

In view of the reported planting of trochus shells during 1936 by the Japanese, it seemed desirable to look into the present abundance of these shell fish. Arrangements were made by Mr. G. G. Wheeler, USCC Senior Representative, to obtain the services of three Okinawan divers and a small navy patrol craft to visit the reefs in the vicinity of Otta Pass. This was done on May 25th. A small reef, approximately 3/8 of a mile in circumference, was selected for search. Four divers worked around this reef and in an hour and a half obtained 27 trochus shells over three inches in diameter. The trochus were found along the face of the reef in one to two fathoms. The production of four shells per man per hour is extremely low. It is believed that this was not due to an actual scarcity of trochus shells, but to inexperience in locating them.

Fig. 48... Saipan. Beach Seining No. 1. Setting net.
June 1946.

Fig. 49. Saipan. Beach Seining No. 2. Hauling net.
June 1946.

VIII. SAIPAN BEACH SEINING

(June 1946)

The seine crew which operates inshore between the beach and the barrier reef is very expert. There are 12 to 15 men in the crew. Their seine is in sections approximately 200 yards long in each section, eight feet deep, and of 1/4 inch bar, or 1/2 inch stretched mesh. The cotton twine is somewhat heavier than #9. The net is set from a 16 foot, narrow beam skiff of the Okinawan type. Three or four fishermen go in the seine boat and the net is laid out in a half-circle from shore (Fig. 48). The fishermen propel the seine boat with bamboo poles and by a single long sculling oar at the stern. The water in this section is not over three feet deep. The net is set only after a school of fish has been observed from shore. As the net is laid out, fishermen follow it into the water and see that it doesn't foul and is tight on the bottom (Fig. 49). Most fishermen wear goggles and dive down in the water to see that the net is clear. These goggles are of Japanese make and are of wood and plastic construction. If the net is not long enough to reach back to shore, some of the seine crew wade out between the end of the net and shore to keep the fish from breaking out along the open side. Sometimes several hundred pounds of fish are taken on one set of the net. In general, however, this type of fishing is very low in production. Several hauls which we observed did not bring in more than 40 or 50 pounds of fish, most of which were small goat fish from four to six inches in length (Fig. 50). These small fish should not be taken, but, due to the shortage of protein food, it seems too much of a hardship on the population to recommend stopping this type of fishing. However, as soon as production from the sampans is sufficient to supply the daily needs of the native population, it is recommended that the use of seines along shore between Mutcho Point and Susupe Point be prohibited during the months of June, July, and August. The results of this regulation, when put into effect, should be observed carefully and if it does not result in an increased catch of fish - both in number and size - seining along shore should be prohibited in that area throughout the entire year. This regulation should not prevent the catching of fish by means of a throw net.

Figure 50... Saipan. Beach Seining No. 3.
Catch (mostly 4-5 inch goatfish). June 1946.

IX. SEA TURTLES

Sea turtles, both the Hawksbill (Chelonia imbricata) and the Green turtle (Chelonia mydas or japonica) are found throughout the area, but more abundantly in the Carolines, less so in the Marshalls and Marianas. Females come ashore on sandy beaches during late spring and early summer to deposit their eggs, numbering up to 150. A hole is dug in the sand above high water mark, the eggs laid in it buried, and left to be incubated by the sun. The young hatch out at the end of 60 days and immediately take to the water.

The Hawksbill, being carnivorous, is not highly regarded as food. The 13 large plates or scutes on the back constitute the "tortoise shell" of commerce. Market value of the plates depends largely on their coloration, the plain dark plates having less value than ones with a greater proportion of light area.

According to Japanese reports, about 200 turtles were taken annually, mostly from Palaus, Truk, and Ponape. This small production reflects the rigid Japanese measures protecting the Hawksbill. No turtles or their eggs could be taken on shore, at which time they are very easy to capture, and no individual could be taken measuring less than 60 centimeters (24 inches) in length. The catch was made offshore, either by spearing or with special large mesh nets made of sennit.

The Green turtle does not have the overlapping plates like the Hawksbill, and has no commercial value. It is herbivorous, and excellent eating. The most common native method of cooking is to bake the animal in its shell.

The Japanese identified the Green turtles as Chelonia japonica (Thunberg). It is quite probably identical with the Philippine species, Chelonia mydas (Linn).

X. POISON FISH

Of the approximately 2000 species of fish and other marine animals in Central Pacific waters, at least 125 are said to be poisonous when eaten. Others, such as cone shells and sea snakes, have a venomous bite, and a third group including corals, sea-urchins and moray eels, cause wounds which frequently become infected and are difficult to heal.

Reasonable precautions can be taken to avoid injury from organisms of the last two groups. Cone shells and sea snakes should not be handled. Wearing shoes (tabis) and gloves when wading or diving, and care in avoiding abrasive contact with corals or stepping on sea-urchins will minimize the danger of wounds from them. Moray eels are found in holes in reefs, so it is inadvisable to reach into such places with bare hands.

But the problem of poisoning from eating fish is a more baffling one. Only the puffers (family Tetrodontidae), and their spiny relatives, the porcupine fish (family Diodontidae) seem to be universally regarded as dangerous. Other species are poisonous in one locality but harmless elsewhere. Even the virulence of the poison varies from place to place, and with season of the year. As far as could be determined, there are no poisonous species in the Palaus. Elsewhere, it is good judgment to follow the recommendations of the native people, who from long experience have come to know the harmful local varieties. The only other generalization is that surface feeding fish, taken by trolling offshore, are not known to be harmful. The poison evidently originates in the food of reef and lagoon fish.

The death of over a score of persons annually, stimulated research by Japanese investigators at the Imperial Naval Hospital, Saipan (Reference 8). It has not been possible to obtain a translation of the reference publication, but according to a translator their conclusions were that the substance responsible was an alkaloid in the blood, and that some measure of protection could be obtained by thorough bleeding, skinning, and washing the flesh of the fish before cooking.

It is believed that additional research is necessary. Certainly the publication cited should be given a careful translation, and the conclusions checked by a competent pharmacologist.

There follows a list of the poisonous species of fish from the Japanese report.

SCIENTIFIC AND COMMON NAMES OF FISHES LISTED AS BEING POISONOUS IN REPORT OF THE INVESTIGATION ON POISONOUS FISHES OF THE SOUTH SEAS, EDITED BY Y. HIYAMA, AND PUBLISHED BY NISSAN FISHERIES RESEARCH LABORATORY

SCIENTIFIC NAME (1)	FAMILY NAME	COMMON NAME English	COMMON NAME Native (Marshalls)	DEGREE POISONOUS
1. Lycodontis flavimarginata (Ruppell)	Muraenidae	Moray Eel	Dreb	Deadly
2. Lycodontis meleagris (Shaw)	"	"	"	"
3. Lycodontis undulata (Lacepede)	"	"	"	"
4. Lycodontis undulata var. isingleenoides (Richardson)	"	"	Maj	Harmless
5. Lycondontis picta (Ahl)	"	"	Dreb	Moderately
6. Lycondontis thyrsoidea (Richardson)	"	"	Maj	Harmless
7. Sphyraena pinuda (Bloch & Schneider)	Sphyraenidae	Barracuda	Jujukob	Deadly
8. Sphyraena forsteri (Cuvier & Valenciennes)	"	"	Jure	Slightly
9. Caranx ascensionis (Cuvier & Valenciennes)	Carangidae	Crevalle	Lane	Small: slightly; Grown: Deadly
10. Caranx sexfasciatus (Cuvier & Valenciennes)	"	"	Ikubuj	Small: slightly; Grown: Deadly
11. Lutjanus vaigiensis (Quoy & Gaimard)	Lutjanidae	Snapper		Slightly
12. Lutjanus bohar (Forskal)	"	"	Baan, Pan	"
13. Lutjanus (Loxolutjanus) sp.	"	"	Jab	Deadly
14. Lutjanus fulviflamma (Forskal)	"	"	Jeblo	Slightly
15. Lutjanus flavipes (Valenciennes)	"	"	Jaj	"
16. Lutjanus semicinctus (Quoy & Gaimard)	"	"	Elikinwi	"
17. Aprion virescens (Valenciennes)	"	"		"
18. Lethrinus miniatus (Schneider)	Lethrinidae	Porgy	Jallia	"
"	"		Ronet	Deadly
19. Lethrinus sp.	"	"	Mameni	Slightly
20. Lethrinus variegatus (Valenciennes)	"	"	Net	Deadly
21. Monotaxis grandoculis (Forskal)	Denticidae	NCN (2)	Kie	"
22. Pentapus aurolineatus Lacepede	"	NCN	Tunal	"

(1) After Fowler - Fishes of Oceania.
(2) No common name

SCIENTIFIC AND COMMON NAMES OF FISHES LISTED AS BEING POISONOUS IN REPORT OF THE INVESTIGATION ON POISONOUS FISHES OF THE SOUTH SEAS, EDITED BY Y. HIYAMA, AND PUBLISHED BY NISSAN FISHERIES RESEARCH LABORATORY

SCIENTIFIC NAME (1)	FAMILY NAME	COMMON NAME		DEGREE POISONOUS
		English	Native (Marshalls)	
23. Callyodon microrhinos (Bleeker)	Callyodontidae	Parrot Fish	Alwor	Slightly
24. Cheilinus sp.	Labridae	Wrasse	Labbo	"
25. Cheilinus fasciatus (Bloch)	"	"	Jollol	"
26. Coris gaimard (Quoy & Gaimard)	"	"	Lukobinatat	Deadly
27. Epibulus insidiator (Pallas)	"	"	Mo	Slightly
28. Cephalopholis argus (Schneider)	Serranidae	Sea-Bass	Kalemej	"
29. Plectropomus truncatus (Fowler)	"	"		"
30. Plectropomus oligacanthus (Bleeker)	"	"	Jule	Deadly
31. Variola louti (Forskal)	"	"	Kaikbet	"
32. Serranus fuscoguttatus (Forskal)	"	"	Kuro	"
33. Serranus sp.	"	"		Slightly
34. Serranus microdon (Bleeker)	"	"	Illino	Deadly
35. Ctenochaetus strigosus (Bennett)	Hepatidae	Surgeon-Fish	Diebdro	Slightly
36. Ctenochaetus sp.	"	"	Teo	"
37. Hepatus olivaceus (Schneider)	"	"	Ael	Moderately (?)
38. Hepatus nigrofuscus (Forskal)	"	"	Diebdro	Slightly (?)
39. Zebrasoma veliferum (Bloch)	"	"	Laid	"
40. Odonus niger (Ruppel)	Balistidae	Trigger-Fish	Bubor bubmej	Deadly
41. Balistes conspicillium (Bloch & Schneider)	"	"	Bub	Moderately
42. Alutera scripta (Osbeck)	Monacanthidae	File-Fish		Deadly (Internal organs only)
43. Holacanthus discanthus (Gunther)	Chaetodontidae	Butterfly-Fish	Jorur	Slightly
44. Abudebduf sexfasciatus (Lacepede)	Pomacentridae	Damsel-Fish	Bakej	Slightly or Harmless

(1) After Fowler - Fishes of Oceania.

PART III

SUMMARY AND RECOMMENDATIONS

A. SUMMARY

1. General Summary

The superficial nature of the Survey cannot be too strongly emphasized. Fundamental knowledge of the fisheries is almost non-existent. Such basic facts as the times of spawning, rates of growth, age at maturity, survival, food habits, and environmental factors, remain unknown. Basic information of this kind can be obtained only by trained fishery experts working over a period of years. A knowledge of these factors is the only sound basis for the establishment of permanent conservation measures, or for the exploitation of the fisheries themselves.

Administrative officers will find that aside from the few exceptions to be mentioned below, the natives are able to obtain the necessary sea food for their diet by the use of their traditional methods. As long as their present way of life remains relatively unchanged, it will be found that no purpose would be served in attempting to introduce different or supposedly more modern methods of fishing. The reefs and lagoons have a resident population of sea foods ample to provide the daily requirements throughout the year and it is not necessary to attempt to build up supplies for use in periods of shortage. To do so would require either the introduction of methods of salting, drying, and storage, or the installation of refrigeration equipment with attendant maintenance problems usually beyond the means or the capacity of the local people. In the field of water transportation, no means of private travel has been found more economical than the paddling or sailing canoe, and the introduction of small craft powered with outboard or inboard marine engines should be dependent on specific local needs.

Exceptions to the above general conditions are limited to localities having large military installations, or to places badly damaged by military operations. In the former category are Guam and Saipan, and in the latter Rota, the Palaus in the vicinity of Koror, Truk, and Ponape. The labor requirements of military establishments on Guam and Saipan have made fishing a commercial, rather than a subsistence, proposition. In the vicinity of Koror, destruction of native boats, canoes, houses, buildings, and other facilities was so nearly complete as to require several years for recovery. In the meantime they need considerable assistance in rehabilitation. At truk and Ponape the Japanese dynamited the lagoon and reef areas to obtain food, with the result that several years will be required for a return to a normal fish population. In the meantime, the native requests for assistance in obtaining fishery supplies and equipment should be filled as speedily as possible.

2. Information on Fishing Supplies

Fish hooks are designated in size from small to large by two series of numbers, the first from sixteen down to one, and the second beginning with 1-0 and progressing up to 12-0. The small size hook is therefore #16 and the largest size hook is #12-0. Six sizes will cover practically all of the needs of the native fishermen. These could be sizes 8, 5, 2, 2-0, 5-0, and 8-0. The most practical shape is that known as "O'Shaughnessy" and the hooks should be tinned. For trolling and for heavy line fishing, a hook similar to the Pfleuger "martu" in sizes of 8-0, 10-0, and 12-0 will be found suitable.

Three sizes of cotton twine, either tarred or untreated, should be provided. Tarred twine has the disadvantage of "burning" if stored in bales for more than a few months. For hand line fishing, the sizes should be #20, #40, and #60. This twine is put up in hanks of two to four pounds each. For making seines, cotton seine twine of sizes #9, #12, and #15 will be found suitable. For making throw nets, linen twine of sizes #20 and #25 will be satisfactory. Approximately two pounds of linen twine are required to make one net and the twine comes in half pound coils.

Stainless steel leader wire is ordinarily packaged in quarter-pound coils. These should be obtained in sizes 9, 11, 14, and 16.

For trolling it is necessary to have swivels of the so-called "barrel" type, which should be procured in sizes known as small, medium, and large. These must be of brass.

For making spears, steel rods in lengths of four feet or over, should be obtained, in sizes of 1/4 inch and 3/8 inch diameter.

3. Construction of Fishing Vessels for Native Use

In the Palaus, Saipan, Truk, and Ponape the natives are now very much dependent on reconditioned Japanese sampans for transportation and such offshore fishing, as they are able to do. Outside of these, they have only their own sailing and paddling outrigger canoes. With few exceptions, the motor vessels they obtained from the Japanese are in very bad condition, both as to hull and engines. Many are powered with Japanese one-cylinder semi-diesel engines; others with heavy duty gasoline engines, burning about 60 octane fuel. The majority of these vessels cannot be expected to last over another three years - many not over a year. Some means must be found for replacing these boats, ranging in length from 30 to 65 feet. They cannot be replaced with military vessels because of unsuitability, high cost of purchase, lack of maintenance facilities (including parts), and cost of operation and maintenance.

The natives need a type of vessel on the order of the Japanese sampan to be powered with a similar type engine, modified to operate on our 50 cetane diesel fuel.

B. RECOMMENDATIONS

Following are the recommendations for the administration of the fisheries of the former Japanese Mandated Islands:

1. Immediate

(1) Revalidate immediately the conservation measures adopted by the Japanese (1936 revision) for the protection of marine resources. The Japanese fisheries regulations were sound and should remain in force until further study shows a need for modification.

The natives are thoroughly familiar with the Japanese conservation measures, and it is recommended that they be put into effect again. These regulations will be found in Civil Affairs Hand Books for various areas and are summarized in Civil Affairs Guide OPNAV 50E-20, dated 15 August 1944, entitled "The Fishing Industry of the Japanese Mandated Islands". The use of poisons, explosives, and electricity in the taking of sea foods was expressly forbidden except by permission. In view of the many accidents which have occurred, especially from the use of Japanese hand grenades, the prohibition in regard to the use of explosives should be rigidly enforced. The use of poisons also should be strictly controlled, since they destroy large numbers of small fish. Temporary exceptions may be made in certain places, such as Koror in the Palaus, Truk, and Ponape, where unusual shortages of sea food warrant the use of poisons as an emergency measure.

a. Licenses. Under Japanese administration commercial fishing, as distinct from subsistence fishing, was subject to license and regulation. No opinion is expressed here in regard to fees for licenses, or fines for violation of regulations. The licensing system, however, provides a simple method of obtaining statistical information on the extent of the fisheries. Some restriction on the exploitation of marine resources is necessary if they are to be self-perpetuating.

b. Closed seasons. These should be continued in effect for trochus during the period July 1 to April 30, permitting the taking of them only during a two week period in either May or June; pearl oysters during the period August 1 to December 31; hawksbill turtles, Chelonia imbricata (from which tortoise shell is obtained) to be protected from June 1 to August 31 and from December 1 to January 31.

c. Size limits. Regardless of the open seasons, trochus shells should not be taken of a size less than three inches (8 centimeters) in diameter at the base. A rough measure is the width of four fingers. Hawksbill turtles and other sea turtles should not be taken if the maximum length of the shell is less than 24 inches (60 centimeters), and no sea turtles or their eggs should be taken when found on shore.

(2) Trochus, whether occurring naturally, or planted by the Japanese, should be designated as the property of the native peoples, and administered as a self-perpetuating resource. The fishery for this animal should be left entirely in native hands.

(3) Appoint a fisheries administrator whose chief functions should include the following:

a. Promulgate and enforce regulations for the protection of marine resources as outlined in paragraph 1 above.

b. Provide technical assistance and information as needed by natives for the establishment and/or continuation of fisheries enterprises. This includes training programs in fishing methods and processing techniques to place them on an equal basis with fishermen and processors of other nations.

c. Assist natives in locating or expanding export markets for fisheries products.

d. Plan and supervise investigations leading to: (1) a better understanding of the fisheries especially with respect to abundance, migrations, propagation etc., to insure intelligent protection and utilization; (2) improved methods of catching fish, and of handling and preparing fishery products for successful competition in the export market.

e. Collect and disseminate statistical information on the fisheries.

f. Issue licenses for authentication by the senior administrative officer.

g. Report annually to the governing agency on the activities of the office, the status of the fisheries, and what benefits, if any, have accrued to the native people as a result of the administration of the fisheries.

In accomplishing these functions, a staff will be necessary, including practical fishermen, technologists, biologists and statisticians for varying periods of time, according to the kind and importance of the project. Where possible, personnel should be obtained on detail from other agencies of Government.

(4) Take immediate steps toward re-establishment in native hands of the former Japanese commercial fisheries for bonito and tuna. This will serve the dual purpose of providing income to natives and contributing to the short protein food supply of the Orient.

Such a permanent, long-range program is predicated on one or another, possibly a combination, of the following methods:

a. Financial support of Government for purchase of fishing vessels, equipment and supplies; construction and maintenance of shore facilities; providing transportation both within and outside the area; obtaining managerial and technical personnel.

b. Authorized exploitation of the fisheries by private capital with proper safeguards for native interests.

2. Subsequent

Recommendations have been made above for satisfying the immediate needs of fisheries administration in Micronesia. But there is a longer view, with a more permanent set of values. The only real foundation for intelligent protection and use of a resource is knowledge of it, and this comes from research. The Japanese knew this and established their Marine Fisheries Experiment Station at Koror, Palaus, in 1932. The fruits of their investigations should be made public, but it certainly will be found that a very large amount of fundamental research remains to be done. It cannot be done by administrative officers or by trade program specialists of the U. S. Commercial Company. Such extensive facilities and trained personnel could be provided only by the appropriate research agency of the Government. For if the United States is to carry out its obligations, pure as well as applied fisheries research must be encompassed. As evidence of the fields in which investigations can prove valuable, there is appended a very brief outline for a fisheries research program of Micronesia.

OUTLINE
FOR AN INVESTIGATION OF THE FISHERIES OF MICRONESIA

I. Catalog of marine resources
   A. Animal
      1. Identification
         a. Invertebrates
            Shellfish, including bi-valves, uni-valves, crabs, shrimp, and lobster
            Sea-urchins, starfish, sea-cucumbers, sponges
         b. Vertebrates
            Fish, including eels, sharks, and rays
            Mammals: porpoises, whales

   B. Plants (Sea-weeds)
      1. Identification
      2. Where found
      3. Abundance
      4. Use
         a. Direct: food for people; commercial; agar
         b. Indirect: food for marine organisms; protection for young fish and shellfish

II. Biology of Marine Organisms
   A. Life Histories
      1. Time of spawning
      2. Rate of growth
      3. Age at maturity
      4. Food habits
      5. Migrations
      6. Longevity

   B. Ecology
      1. Natural environment
      2. Effect of environmental changes
      3. Relationship to other animals and plants

III. Oceanography
   A. Physical characteristics in Micronesia
      1. Prevailing winds, seasonal strength and direction
      2. Coastal rainfall and drainage systems
      3. Tides and currents, including wave action
      4. Conformation of reefs and lagoons
      5. Character of bottom
      6. Angle of slope from shore seaward
      7. Temperature and salinity fluctuations of sea water

IV. Subsistence Fishing
   A. Inshore
      1. Species
      2. Seasonal abundance
      3. Methods of capture
         a. Drop line
         b. Set line
         c. Trolling

d. Traps
e. Seines and gill-nets
f. Other

4. Processing
   a. Eaten raw, cooked, dried, smoked, etc.
5. Fishing equipment
   a. Present boats, supplies
   b. Requirements, improvements, costs

B. Offshore
   Appropriate subheadings as above

V. Production for Income (Export)

A. Species
   1. Abundance, potential production
   2. Methods of capture
      a. Vessels, gear and personnel needed
   3. Methods of Processing
      a. Shore facilities and personnel needed for salting, wet or dry; smoking; canning; other
   4. By-products
      a. Oil
         Edible, vitamin A
         Industrial: paint, soap, etc.
      b. Meal, for fertilizer or stock-feed
      c. Hides, fins

B. Economic Factors
   1. Cost of Production
   2. Investment required
   3. Competition in world markets
   4. Demand in foreign and domestic economy

VI. Conservation of Resources

A. Regulations for
   1. Protection of resources from over-fishing
   2. Assuring maximum production

B. Fish Culture
   1. Artificial propagation and transplanting

C. RECOMMENDATIONS FOR GUAM FISHERIES

1. Commercial and Sport Fishing

Because of the many difficulties in establishing an offshore fishery for bonito and tuna, and the scarcity of smaller fish along the inshore coast of Guam, it seems probable that the most promising extension of the fisheries would be to increase or encourage production by means of gill nets at night and especially in the Umatac area. As they are already experienced in the use of seines and gill nets, it would only be necessary to furnish several seines approximately 400 yards long and with a stretched mesh from 2 3/4 inches to 3 3/4 inches. Since this would be an experimental project, it should not be expected that the fishermen themselves would be able to purchase these seines, especially as one or more sizes might be found unsuitable for fishing in that area.

One aspect of fishing which is worthy of additional attention is the development of sport fishing. The recreational value of fishing is, of course, well understood and is being taken care of in part by the services themselves. However, there is now, and undoubtedly will continue to be, an increasing demand for fishing guides with small party boats to take out from two to four people. The abundance of marlin, sail fish, barracuda, wahoo, and various members of the tuna family, warrants the establishment of a small fleet of sport fishing vessels. Such a project has not only a recreational value, but will in time develop a number of fishing guides with sufficient knowledge of offshore fishing to contribute directly to the production of food fish. In general, party boats are hired on weekends and during the major portion of the week these fishermen would be able to produce fish for food.

2. Fishing Vessels

It is believed that any system of renting surplus vessels and small craft to native fishermen will prove unsatisfactory, whether it be for commercial fishing or for sport fishing. It has been found everywhere throughout the fishing industry that private ownership of fishing vessels tends to promote more efficient operation and to increase production. It is recommended that the administrative section in charge of surplus vessels explore the possibilities of putting some surplus craft into private ownership with qualified individuals.

3. Special Fisheries Regulations

In order to protect the future survival of the many species of fish found close inshore it is recommended that regulations be made for minimum size limits on fish taken in the traps and surround nets along shore. In the absence of information on the rate of growth and maturity of the various species taken at Guam, it is impossible to recommend minimum sizes for the separate species. In any case, it is believed that the requirements of conservation would be met by prohibiting the taking of small fish of any species under six inches in length. The difficulties of enforcing such a regulation are fully recognized, but it is thought that they will not be found to be greater than is the case in the United States. If it serves no other purpose, it may bring to the attention of the people the necessity for conserving their marine resources. The regulation would not apply to fish taken for live bait, or caught with throw-nets.

4. Japanese Fishing Hampered by Sharks

As nearly as could be determined, the two most abundant species of tunas are the ocean bonito or katsuo (Katsuwonus (Euthynnus) pelamis), weighing from 10 to 25 pounds, and the yellow fin tuna (Neothunnus macropterus), which weighs up to 60 pounds. Schools are almost always of uniform size and weight. During their occupation of Guam the Japanese did a limited amount of tuna fishing, but were bothered by an abundance of sharks which attacked and chewed off part of the hooked fish. It was the custom to send a diver down with a knife to kill the sharks. It was not possible to determine the abundance of sharks, but if they are very common a limited fishery might be established to get the shark livers for vitamin A. Because most of the sharks found here are sand sharks (Eulamia) of comparatively small size, being under seven feet in length, it is doubtful if the vitamin A content of the liver oil is high enough to warrant shipment to the United States, but it could be utilized as a supplement to the stock and poultry feeds of the Islands, or offered to the Japanese trade. The fins and hides could be marketed and the carcass either sold fresh, or put through a reduction plant to make stock feed or fertilizer.

PART IV

NATIVE NAMES RELATING TO THE FISHERIES

Albacore THUNNUS GERMO
Ahipalaha (Hawaiian) Not recognized (Jaluit) Jilo (Majuro) Aün or Toku (Truk)
Not recognized (Ailinglapalap) Not recognized (Kusaie)

Anchovy ANCHOVIELLA PURPUREA
Nehu (Hawaiian) Aol (Jaluit) Jepeor (Majuro) Lesabil (Ailinglapalap)
Aletses (Marianas) Much or Nou (Truk) Ikatik (Ponape) Shaguru (Palaus)

Angel fish CENTROPYGE SP.
Chukufan nimuk (Truk)

Any sting ray DASYATIS-AETOBATIS
Jomjo (Majuro)

Barracuda SPHYRAENA BARRACUDA
Kaku (Hawaiian) Metua (Majuro) Jure (Ailinglapalap) Alu (Marianas)
Sawraw (Ponape) Twolah (Kusaie) Yono (Kapingamarangi)

Big-eye, red PRIACANTHUS CRUENTATUS
Aweoweo (Hawaiian) Lol (Jaluit) Lol (Majuro) Lol (Ailinglapalap)
Asondon (Truk)

Big-eyed scad SELAR CRUMENOPHTHALMUS
Akule (Hawaiian) Akole (Majuro) Not recognized (Ailinglapalap)

Blue runner SCOMBEROIDES SANCTI-PETRI
Lai (Hawaiian) Not recognized (Majuro) Änwes (Truk)

Bone fish ALBULA VULPES
O'io (Hawaiian) Beleo (Majuro) Beleo (Ailinglapalap) Küenifat (Truk)
Not recognized (Kapingamarangi)

Bonito, little tunny EUTHYNNUS ALLETTERATUS
Kawakawa (Hawaiian) Loj (Jaluit) Loj (Majuro) Lejabil (Ailinglapalap)
Angarap (Truk) Not recognized (Kusaie) Tawatawa (Kapingamarangi)

Butterfly or Angel fish CHAETODON UNIMACULATUS
Yellow manini (Hawaiian) Jorur (Jaluit) Ripop (Majuro) Kibab (Ailinglapalap)
Tihitihi (Kapingamarangi)

Butterfly fish CHAETODON SETIFER
Kika Kapu (Hawaiian) Liarpwater (Ponape) Siti (Kapingamarangi)

Butterfly fish FORCIPIGER LONGIROSTRIS
Lauwiliwili (Hawaiian) Siti (Kapingamarangi)

Butterfly fish HENIOCHUS ACUMINATUS
Kihikihi loulu (Hawaiian) Tautahi (Kapingamarangi)

Butterfly fish HOLACANTHUS DIACANTHUS
Nukunimuenipach (Truk)

Cardinal fish AMIA FRENATA
Upapalu (Hawaiian) Not recognized (Jaluit) Ongong (Majuro)
Pan (Ailinglapalap) Tikupe (Kapingamarangi)

Crevalle CARANXMATE
Omaka (Hawaiian) Mano (Majuro) Mano (Ailinglapalap)

Crevalle, black CARANX SEXFASCIATUS
Ulua lauli (Hawaiian) Ikbwij (Jaluit) Langne (Majuro) Ikbwij (Ailinglapalap)
Ulua (Kapingamarangi)

Crevalle, blue CARANX STELLATUS
Omilu (Hawaiian) Drelbokrok (Majuro) Langne (Ailinglapalap) Pweas (Truk)
Tialega (Kapingamarangi)

Crevalle, silver BLEPHARIS CILIARIS
Ulua kihikihi (Hawaiian) Kupkup (Majuro) Molosetak(Ailinglapalap)
Chopchop (Kusaie) Ulua (Kapingamarangi) Orduedl (Palaus)

Crevalle, silver-young BLEPHARIS CILIARIS
Jolokmor (Jaluit) Ollangne (Majuro)

Crevalle, striped GNATHANODON SPECIOSUS
Paopao (Hawaiian) Lojinarinmun (Jaluit) Rewa (Majuro) Rewa (Ailinglapalap)
Sapwelepwel (Ponape) Selemang (Kapingamarangi)

Crevalle, white CARANGOIDES AJAX
Ulua (Hawaiian) Arong (Jaluit) Majeik (Majuro) Miseik (Ailinglapalap)
Ulua (Kapingamarangi)

Crevalle, yellow fin CARANX IGNOBILIS
Pauu'u (Hawaiian) Ikelonam (Majuro) Tettin Poŭr (Truk) Orung (Ponape)

Damsel fish ABUDEFDUF ABDOMINALIS
Mamo (Hawaiian) Baretilola (Jaluit) Paret (Majuro) Irel (Ailinglapalap)
Palae (Kapingamarangi)

Damsel fish ABUDEFDUF SORDIDUS
Kupipi (Hawaiian) Baret (Jaluit) Paret (Majuro) Irel (Ailinglapalap)
Paruk (Kusaie)

Dolphin CORYPHAENA HIPPURUS
Mahimahi (Hawaiian) Koko (Jaluit) Koko (Majuro) Koko (Ailinglapalap)
Sopoor (Truk) Not recognized (Ponape) Not recognized (Kusaie)
Mahimahi (Kapingamarangi)

Eel, white conger CONGER CINEREUS
Puhiuha (Hawaiian) Maojokur (Jaluit) Mojour (Majuro) Ton (Ailinglapalap)
Niseningening (Truk) Lapwethpwetepwet (Ponape) Pon (Kapingamarangi)
Puhi (Palaus)

Flounder PLATOPHRYS SP.
Pakii (Hawaiian) Bale (Jaluit) Bale and Barij (Majuro) Bale (Ailinglapalap)
Fichan (Truk) Lipar (Ponape) Pukawn (Kusaie) Piepie (Kapingamarangi)

Flying fish CYPSELURUS
Malolo (Hawaiian) Jojo (Jaluit) Jojo (Majuro) Jojo (Ailinglapalap)
Gaga (Marianas) Menger chocho (Truk) Mangar (Ponape) Mukol (Kusaie)
Tave (Kapingamarangi) Kok (Palaus)

Goat fish MULLOIDICHTHYS AURIFLAMMA
Wekeula (Hawaiian) Jo or sho (Eniwetok) Motal (Jaluit) Jo (Majuro)
Jo (Ailinglapalap) Tiau (Marianas) Putfut (Kusaie) Matuwaedau (Kapingamarangi)

Goat fish PSEUDUPENEUS MULTIFASCIATUS
Moano (Hawaiian) Not recognized (Jaluit) Matal (Majuro)
Not recognized (Ailinglapalap) Matukurao (Kapingamarangi)

Goat fish PSEUDUPENEUS PLEUROSTIGMA
Malu (Hawaiian) Jerobwe (Jaluit) Joroppa (Majuro) Jorobe (Ailinglapalap)
Matukurao (Kapingamarangi)

Goat fish PSEUDUPENEUS PORPHYREUS
Kumu (Hawaiian) Jo (Jaluit) Jome (Majuro) Not recognized (Ailinglapalap)

Goat fish PSEUDUPENEUS SP.
Mwathal (Ponape)

Goat fish UPENEUS ARGE
Wekepueo (Hawaiian) Jolukmor (Majuro)

Goat fish UPENEUS TAENIATUS (CHRYSONEMUS)
Mwathal (Ponape)

Grouper, br. spotted SERRANUS SP.
Giro (Jaluit) Seiau (Truk) Kepwaip (Ponape) Kalishuk (Kusaie) Yalus (Palaus)

Hawk fish CIRRHITUS PINNULATUS
Po'opa'a (Hawaiian) Kiriej (Majuro) Mataramae (Kapingamarangi)

Hawk fish, black sided PARACIRRITES FORSTERI
Hilu piliko's (Hawaiian) Kiriej and japeno (Majuro) Maulung (Kapingamarangi)

Hawk fish, white lined PARACIRRITES ARCATUS
Piliko'a (Hawaiian) Beroilowor (Jaluit) Larikiranwor (Majuro)

Lizard fish SAURIDA GRACILIS
Ulae (Hawaiian) Jujukop (Majuro)

Mackerel DECAPTERUS SANCTAE - HELENAE
Opelu (Hawaiian) Not recognized (Majuro) Not recognized (Ailinglapalap)
Esinou manouchis (Truk)

Marlin TETRAPTURUS
A'u (Hawaiian) Lejikan (Majuro) Makoro (Jap.) (Marianas) Takinar (Truk)
Sakurah (Kapingamarangi)

Milk fish CHANOS CHANOS
Awa (Hawaiian) Baleo (Jaluit) Not recognized (Majuro)
Not recognized (Ailinglapalap) Ach (Truk) Matakarati (Kapingamarangi)

Moorish idol ZANCLUS CANESCENS
Nikaskas (Truk) Sensarok (Ponape) Tautahi (Kapingamarangi)

Moray, Brown LYCODONTIS FLAVOMARGINATA
Puhi (Hawaiian) Maj (Jaluit) Maj (Majuro) Maj (Ailinglapalap) Kasabagu (Palaus)
Not recognized (Ponape) Kokwan or Semus (Kusaie) Kiha (Kapingamarangi)

Moray eel LYCODONTIS THYRSOIDEA
Ikür (Truk)

Mountain Bass DULES SP.
Aholehole (Hawaiian) Ilmok (Majuro) Not recognized (Ailinglapalap)
Auwe (large) (Kusaie) Ef (small) (Kusaie) Owati (Kapingamarangi)

Mullet, false NEOMYXUS CHAPTALII
Uouoa (Hawaiian) Iul (Majuro) Sarau (Truk)

Mullet, Gray MUGIL CEPHALUS
Amaama (Hawaiian) Eol (Jaluit) Iul (Majuro) Iul (Ailinglapalap)
Aguas (Marianas) Nieuretin (tiny) (Truk) Purei (small) (Truk) Ikang (Truk)
Limwer (Ponape) Beah (Kusaie) Kanai (Kapingamarangi)

Needle fish, Gar BELONE PLATYURA
Ahaaha (Hawaiian) Eddak (Jaluit) Tak (Majuro) Tak (Ailinglapalap)
Ave pek and Mauken (Truk) Tak (Ponape) Yok (Kusaie) Aku (Kapingamarangi)

Ocean bonito, skipjack KATSUWONUS PELAMIS
Aku (Hawaiian) Lajabwil (Jaluit) Lejabil (Majuro) Lejabil (Ailinglapalap)
Bonito (Marianas) Karangap (Ponape) Katsuo (Jap.) (Kusaie) Kadosan (Palaus)
Atu (Kapingamarangi)

Parrot fish CALLYODON FORMOSUS
Lauia (Hawaiian) Masaraweth (Ponape) Timau (Kapingamarangi)

Parrot fish CALLYODON FORSTERI
Panuhunuhu (Hawaiian) Pworos (Ponape)

Parrot fish CALLYODON PERSPICILLATUS
Uhu (Hawaiian) Mao (Jaluit) Merla (Majuro) Perak (Ailinglapalap)
Lagua (Marianas) Perakea (Kapingamarangi)

Parrot fish, blue CALLYODON JORDANI
Ru (Truk) Mau (Ponape) Masok and Folfol (Kusaie) Uho (Kapingamarangi)

Parrot fish, general
Ikonochi (Truk)

Porgy MONOTAXIS GRANDOCULIS
Mu (Hawaiian) Not recognized (Majuro) Not recognized (Ailinglapalap)
Mu (Kapingamarangi)

Puffer, Balloon fish TETRADON HISPIDUS
O'opuhue (Hawaiian) Wat (Jaluit) Luap (Majuro) Wat (Ailinglapalap)
Nipou (Truk) Wata (Ponape) Nemata (Kusaie) Sete and Tiwadi (Kapingamarangi)

Puffer, porcupine CHILOMYCTERUS SP. - DIODON SP.
O'opu okala (Hawaiian) Mojannur (Jaluit) Japonke (Majuro) Mejangir (Ailinglapalap) Sou nichukew (Truk) Soutu (Kapingamarangi) Derudn (Palaus)

Razor fish INISTIUS PAVO
Laenihi (Hawaiian) Roba (Jaluit) Tinelikop (Majuro) Raperape (Kapingamarangi)

Red snapper ETELIS MARSHI
Ulaula (Hawaiian) Winam (Truk) Suekoro (Kapingamarangi)

Rock skipper, zebra SALARIAS ZEBRA
Pao'o (Hawaiian) Kitok (Majuro) Jibbalang (Ailinglapalap)
Pakauroh (Kapingamarangi)

Rudder fish KYPHOSUS FUSCUS
Nenue (Hawaiian) Rana (Eniwetok) Bajrok (Jaluit) Bejeruk (Majuro)
Kabat (Ailinglapalap) Nimmueriod tinipu (Truk) Umula (Ponape)

Sail fish ISTIOPHORUS ORIENTALIS
A'u lepe (Hawaiian) Ujinlep (Jaluit) Ujinlep (Majuro) Ujileb (Ailinglapalap)
Sakurahanu (Kapingamarangi)

Sand fish (Wrasse) LEPIDAPLOIS BILUNULATUS
A'awa (Hawaiian) Pan (Majuro) Juajo (Ailinglapalap)

Scorpion fish SCORPAENOPSIS GIBBOSUS
Nohu (Hawaiian) Nu (Majuro) No (Ailinglapalap) Neu (Ponape)
Nohu (Kapingamarangi)

Shark, hammerhead SPHYRNA ZYGAENA
Manokibikihi (Hawaiian) Not recognized (Jaluit) Bakototo (Majuro)
Paakooijo (Kusaie) Matautarina (Kapingamarangi)

Shark, white CARCHARODON CARCHARIAS
Mano (Hawaiian) Bako (Jaluit) Bako (Majuro) Bako (Ailinglapalap)
Halu (Marianas) Poko P̈achäu (Truk) Pawkaw (Ponape) Paako (Kusaie)
Sokoulu (Kapingamarangi) Meluyes (Palaus)

Snapper APRION VIRESCENS
Uku (Hawaiian) Mola (Eniwetok) Not recognized (Jaluit) Ewae (a-y) (Majuro)
Laon (Ailinglapalap) Ä̈anüch and Auwo (Truk) Tutu (Kapingamarangi)

Snapper LETHRINUS RETICULATUS
Mafuti (Marianas)

Snapper, brown PRISTIPOMOIDES SP.
Opakapaka (Hawaiian) M̈ör̈op (Truk)

Squirrel fish HOLOCENTRUS DIADEMA
Alaihi (Hawaiian) Kur (Jaluit) Kur (Majuro) Mun (Ailinglapalap)
Utei (Ponape) Mukas (Kusaie)

Squirrel fish HOLOCENTRUS FURCATUS
Malau (Kapingamarangi)

Squirrel fish HOLOTRACHYS LIMA
Mutu (Hawaiian) Showlah (Kusaie) Malau (Kapingamarangi)

Squirrel fish HOLOCENTRUS-SCYTHROPS
Alaihi or Uu (Hawaiian) Tanseu or Pankir (Ponape) Suekoro (Kapingamarangi)

Squirrel fish HOLOCENTRUS SPINIFER (LEO)
Alaihi or Uu (Hawaiian) Sara (Ponape) Ita (Kapingamarangi)

Squirrel fish HOLOCENTRUS XANTHERYTHRUS
Alaihi or Uu (Hawaiian) Satoro (Kapingamarangi)

Squirrel fish MYRIPRISTIS CHRYSERES
Olalmetah (Kusaie)

Squirrel fish, red MYRIPRISTIS MURDJAN
U'u (Hawaiian) Mun (Jaluit) Mun (Majuro) Munkiren (Ailinglapalap)
Mun (Ponape) Alolmetah (Kusaie) Marapun and Malau (Kapingamarangi)

Sting ray, spotted AETOBATUS NARINARI
Hihimanu (Hawaiian) Imin (Jaluit) Imen (Majuro) Imen (Ailinglapalap)
Nifaro Feianap (Truk) Ashesha (Kusaie) Hai (Kapingamarangi)

Surgeon fish HEPATUS ACHILLES
Pakuikui (Hawaiian) Efen (Truk) Teripa (Kapingamarangi)

Surgeon fish HEPATUS LEUCOPAREIUS
Maiko (Hawaiian) Iel (Jaluit) Mok (Majuro) Jemenmej (Ailinglapalap)

Surgeon fish HEPATUS LINEOLATUS
Kew (Kusaie)

Surgeon fish, black HEPATUS FULIGINOSUS
Walu or Pualu (Hawaiian) Pulan king (Ponape) Batbat (Kusaie)
Asangal (Palaus)

Surgeon fish, brown HEPATUS BARIENS
Pualu (Hawaiian) Begru (Jaluit) Pekru (Majuro) Kebat (Ailinglapalap)
Tiripa (Kapingamarangi)

Surgeon fish-tang ZEBRASOMA VELIFERUM
Kihikihi (Hawaiian) Piepwerik (Truk)

Surgeon fish, red CTENOCHAETUS STRIGOSUS
Kole (Hawaiian) Ael (Isle) (Majuro) Tebro (Ailinglapalap) Tomorok (Ponape)

Surgeon fish, striped HEPATUS TRIOSTEGUS
Manini (Hawaiian) Kuban (Eniwetok) Kuban (Jaluit) Kubang (Majuro)
Kubang (Ailinglapalap) Lete pwel (Ponape) Lashfol (Kusaie)
Manini (Kapingamarangi)

Surgeon-unicorn NASO LITURATUS (CALLICANTHUS)
Kala (Hawaiian) Pulankin (Ponape)

Sword fish XIPHIAS GLADIUS
A'u (Hawaiian) Lajkan (Jaluit) Lejiken (Majuro) Leserkam (Ailinglapalap)
Eco (Kusaie)

Ten Pounder ELOPS MACHNATA
Awa'aua (Hawaiian) Not recognized (Majuro) Beleo (Ailinglapalap)
Kuenifat (Truk) Not recognized (Kapingamarangi)

Thread fish POLYDACTYLUS SEXFILIS
Moi (Hawaiian) Atakuru (Eniwetok) Atkaru (Jaluit) Atkaru (Majuro)
Atkaru (Ailinglapalap)

Trigger fish BALISTAPUS ACULEATUS
Humuhumu nukunuku apua'a (Hawaiian) Pup (Ponape) Humuakeo (Kapingamarangi)
Psugun (Palaus)

Trigger fish BALISTES VIDUA
Humuhumu uli (Hawaiian) Humureng (Kapingamarangi)

Trigger fish, black MELICHTHYS BUNIVA
Humuhumu ele'ele (Hawaiian) Bub (Jaluit) Pup (Majuro) Bup (Ailinglapalap)
Liopwel (Ponape) Foof (Kusaie) Humuhumu humuarape kapek (Kapingamarangi)

Trigger fish, file fish BALISTAPUS RECTANGULUS
Humuhumu (Hawaiian) Imim (Jaluit) Imim (Majuro) Imim (Ailinglapalap)
Pupwilop (Ponape) Fowol (Kusaie) Humutara (Kapingamarangi)

Tuna, yellowfin NEOTHUNNUS MACROPTERUS
Ahi (Hawaiian) Bwebwe (Jaluit) Bwebwe (Majuro) Bwebwe (Ailinglapalap)
Tosan (Marianas) Sengir (Truk) Karangap (Ponape) Allwool (Kusaie)
Takuwah (Kapingamarangi)

Wahoo ACANTHOCYBIUM SOLANDRI
Ono (Hawaiian) Al (Jaluit) Al (Majuro) Al (Ailinglapalap) Ngän (Truk)
Sure (Ponape) Not recognized (Kusaie) Mada (Kapingamarangi) Ngangal (Palaus)

Wrasse ANAMPSES CUVIER
Opole (Hawaiian) Al'le (Jaluit) Allilitol (Majuro) Likob (Ailinglapalap)

Wrasse CHEILINUS UNDULATUS?
Not found (Hawaiian) Mau (Ponape)

Wrasse CHEILIO INERMIS
Kupoupou (Hawaiian) Kiol (Ponape) Tirade hoi (Kapingamarangi)

Wrasse CORIS BALLIEUI
Malamalama (Hawaiian) Tirade hoi (Kapingamarangi)

Wrasse CORIS GAIMARD
Hinalea akilolo (Hawaiian) Kopwili (Ponape) Ti'rape la'pehaupa (Kapingamarangi)

Wrasse CORIS VENUSTA
Tirade hoi (Kapingamarangi)

Wrasse EPIBULUS INSIDIATOR
Feisiu (Truk)

Wrasse GOMPHOSUS TRICOLOR
Hinalea iiwi (Hawaiian) Tikarihimoana (Kapingamarangi)

Wrasse THALASSOMA PURPUREUM?
Awela (Hawaiian) Lwommai (Ponape)

Wrasse THALASSOMA TRILOBATA
Awela (Hawaiian) Likop (Majuro) Lo (Ailinglapalap) Tuhukorolant (Kapingamarangi)

Wrasse VERRICULUS SANGUINEUS
Ti'rape la'pehaupa (Kapingamarangi)

Wrasse, green THALASSOMA UMBROSTYGMA
Hinalea (Hawaiian) Lo (Majuro) Taburbur (Ailinglapalap) At'uhun (Marianas)
Parati'a (Kapingamarangi)

Unicorn fish NASO UNICORNIS
Kala (Hawaiian), Enrok (Jaluit) Moneiou (Majuro) Engirok (Ailinglapalap)
Mecha puna or pon (Truk). Fulak (Kusaie) Hukume karu skau (Kapingamarangi)

NATIVE NAMES FOR SHELLFISH, TURTLES, SPONGES, MISCELLANEOUS

Any shell
Aililin (Marianas)

Any turtle
Wei (Ponape)

Black lip pearl oyster PINCTADA MARGARITIFERA
Ri (Jaluit) Puei (Truk) Pwai emai (Ponape) Tipaa (Kapingamarangi)
Hisoeh (Palaus)

Cat-eye TURBO SP.
Mejenjirul (Eniwetok) Pulan (Moon) (Marianas) Auwänoch (Truk)
Kikmasul (Ponape) Kowing (Kusaie) Aredi (Kapingamarangi) Sungaruk (Palaus)

Cockle ANADARA ANTIQUATA SCAPHA
Lipwoi (Ponape)

Cone shell CONUS LIVIDUS
Lithik (Ponape)

Cone shells CONUS MARMOREUS & SP.
Korokoro (Kapingamarangi)

Coral, mushroom FUNGIA SCUTARIA
Lapawath (Ponape)

Cowrie CYPRAEA MAURITIANA
Libukkwe (Jaluit) Nansilopw (Ponape)

Cowries CYPRAEA, PUSTULARIA SP.
Libuke (Eniwetok) Libbuke (Ailinglapalap) Pun (Truk) Pwili (Ponape
Pu (Kapingamarangi)

Crab, Kona RANINA SERRATA
Not recognized (Jaluit) Not recognized (Majuro) Not recognized (Ailinglapalap)
Not known (Ponape) Not recognized (Kapingamarangi)

Crab, Samoan SCYLLA SERRATA
Likoro (Jaluit) Likorkor (Majuro) Baru (Ailinglapalap) Alemang (Ponape)
Powah (Kusaie) Tupe (Kapingamarangi) Amang (Palaus)

General crab name
Baru (Majuro) Balati (Marianas)

Giant clam TRIDACNA CROCEA
Mejenwor (Jaluit)

Giant clam TRIDACNA ELONGATA
Sila (Ponape)

Giant clam TRIDACNA GIGAS
Mesenwer (Eniwetok) Rimuj (Jaluit) Pasu (Ponape)

Giant clam TRIDACNA SP.
Amuei (Truk) Pahi wah (not present) (Kapingamarangi)

Green turtle CHELONIA JAPONICA OR MYDAS
Kalap (Ponape)

Heart clam CARDIUM ELONGATUM
Tuoweh (Kapingamarangi)

Helmet shell CASSIS CORNUTA
Tipuerede (Kapingamarangi) Omúú (Palaus)

Mantis Shrimp PSEUDOSQUILLA CILIATA
Aloalo (Hawaiian) Rijing (Jaluit) Jor (Majuro) Rising (Ailinglapalap)
Insang (Ponape) Masusu (Kusaie) Aratume (Kapingamarangi)

Nautilus NAUTILUS POMPILIUS & SP.
Yatiri (Kapingamarangi)

Octopus, day POLYPUS MARMORATUS
He'e (squid) (Hawaiian) Ket (Eniwetok) Kwet (Jaluit) Kwet (Majuro)
Kwet (Ailinglapalap) Kis (Ponape) Kwait (Kusaie) Pilipili (Kapingamarangi)
Pugitang (Palaus)

Octopus, night POLYPUS ORNATA
Puloa (Squid) (Hawaiian) Jululinbong (Majuro) Jululinbong (Ailinglapalap)

Olive shells OLIVA SERICEA & SP.
Om (Eniwetok) Akiokoko (Kapingamarangi)

Pinna shell ATRINA VEXILLUM
Pwaiaka (Ponape)

Sand lobster PARIBACCUS ANTARCTICUS
Uraber (Jaluit) Jipukpuk (Majuro) Uraber (Ailinglapalap) Allpap (Kusaie)
Tapatapa (Kapingamarangi)

Sea cucumbers HOLOLHURIA
Jibenben (Ailinglapalap) Bislama (big) (Kusaie) Weh (small) (Kusaie)
Eled (Palaus)

Sea urchin ECHINOMETRA, CENTRECHINUS
Vona (Hawaiian) Rar (Truk) Aal (Kusaie)

Spider shell LAMBIS CHIRAGRA
Jitor (Eniwetok) Neang (Truk) Lang (Ponape) Waiyang (Kapingamarangi)

Spiny lobster PANULIRUS MARGINATUS
Oula (Hawaiian) Nid (Eniwetok) Wor (Jaluit) Wor (Majuro) Arabrukl (Palaus)
Wor (Ailinglapalap) Mahónggang (Marianas) Ungung (Kusaie) Uda (Kapingamarangi)

Sponge
Lim (Ponape)

Tortoise shell from CHELONIA IMBRICATA
Puochen (Truk) Sapake (Ponape)

Trochus TROCHUS NILOTICUS
Like jijot (Eniwetok) Ligarbolul (Jaluit) Tolompu (Marianas) Nikommot (Truk)
Sumum or Tianina (Ponape) Puh (Kapingamarangi) Smum or Ekoik (Palaus)

Trumpet shell CHARONIA TRITONIS
Sawi (Ponape) Fuul (Kusaie) Pumangoro (Kapingamarangi)

White crab PORTUNUS SANGUINOLENTUS
Ejake (Majuro)

Any fish
Ik (Eniwetok)

Derris Root DERRIS ELLIPTICA
Ōp (Kusaie)

Fish trap
Tiu (Kapingamarangi)

REFERENCES

1. (Anonymous) Illustrations of edible fishes in the South Seas (in Japanese). Nissan Fisheries Research Laboratory, Tokyo, 149 colored plates, 1941.

2. (Anonymous) An unidentified typewritten manuscript on the Japanese Fisheries of the South Seas, prepared for SCAP, No title, no date.

3. Day, Francis, Fishes of India. B. Quaritch, London, 1875-1878.

4. Elbert, S. H., Lt. Cdr., USNR, Trukese, English and English-Trukese Dictionary United States Naval Military Government, February 1947.

5. Edmondson, Charles H., Reef and Shore Fauna of Hawaii. Bernice P. Bishop Museum (Honolulu), Special Publication 22, 1933, (revised edition) 1946.

6. Fowler, H. W., The Fishes of Oceania. Bernice P. Bishop Museum (Honolulu), Memoirs, vol. 10, 1928; Supplement 1, Memoirs 11 (5), 1931; Supplement 2, Memoirs 11 (6), 1934.

7. Galtsoff, Paul S., Pearl and Hermes Reef, Hawaii, Hydrographical and Biological Observations. Bernice P. Bishop Museum (Honolulu) Bulletin 107, 49 pp., 5 pls., 9 figs., 1933.

8. Godsil, H. C. & Byers, Robert D., A systematic study of the Pacific Tunas. State of California, Department of Natural Resources, Division of Fish and Game, (Sacremento), Fish Bulletin No. 60, 1944.

9. Herdman, W. A., The Pearl Oyster fisheries of the Gulf of Manaar. Reports to the Government of Ceylon. (The Royal Society of London), vol. 1: 125-146, vol. 2: 37-76, 1903. (Life history.)

10. Hiyama, Yoshio (Editor), Report of the Investigations on Poisonous Fishes of the South Seas (in Japanese). Nissan Fisheries Research Laboratory (Tokyo), 137 pp., 77 colored plates, 1943.

11. Hirase, Shintaro, A collection of Japanese Shells, with illustrations in natural colors. Matsumura Sanshodo (Tokyo), 5th edition, 217 pp., 129 pls., 1936.

12. Hosaka, Edward Y., Sport fishing in Hawaii. Bonds (Honolulu), 198 pp., 1944.

13. Jordan, David Starr and Evermann, Barton Warren, The aquatic resources of the Hawaiian Islands, Part 1, The shore fishes. U. S. Fish Commission Bulletin 23 (1), for 1903. Government Printing Office, Washington, 1905.

14. Moorhouse, F. W., Notes on Trochus niloticus. British Museum (Natural History), Great Barrier Reef Expedition, 1928-29, Scientific Reports 3 (5): 145-155, 1932.

15. U. S. Navy Department, Civil Affairs Guide, OPNAV 50E-20, The Fishing Industry of the Japanese Mandated Islands, 26 pp., map, figs., 15 August 1944.

16. Nichols, A. G., On the breeding and growth rate of the black-lip pearl oyster (Pinctada margaritifera). Great Barrier Reef Committee (Brisbane), Reports 3 (2): 27-31, 1931.

17. Rasalan, Santos B., Preservation of Fishing Gear in Samar Province, Philippines. Philippine Journal of Science, Vol. 73, pp. 321-333, Manila, 1940.

18. Sugiura, Kenichi, Fishing and fishing implements of the people of Yap. (In Japanese). Anthropological Society of Tokyo, Journal 54 (616): 54-65, 7 figs., February 1939.

19. Thompson, Laura, Fishing in Guam. The Guam Recorder, 54-56, 80-81, May 1941.

20. Tinker, Spencer W., Hawaiian Fishes. Tongg Publishing Co. (Honolulu), 404 pp.,Figs.,1944.

21. Whitley, G. P., Poisonous and harmful fishes. Council for Scientific and Industrial Research, Commonwealth of Australia (Melbourne), Bulletin 159, (Division of Fisheries Report No. 10), 1943.

INDEX

Page

Area
of Unmapped Islands 1
of Micronesia 1

Baitfish (Also see under Fish)
Boatfish 5
Nenu 5, 44, 55

Bonito (Skipjack), Katsuwonus pelamis
Fishery for
Ailinglaplap 7
Japanese 64
Kwajalein 18
Palaus 48
Ponape 20
Rota 55
Saipan 50, 64
Tinian 52
Truk 75

Bonito Sticks
Japanese method 59
Lusaie 18
Truk 33

Cannery, Japanese
Palaus 70

Canoes, native
Guam 57
Kapingamarangi ..... Fig. 16 30
Lusaie ..... Fig. 9 18
Marshallese 15
Palaus ..... Fig. 26 ..... 39, 46

Cast-net (See under Throw-net)
Clams (See under Shells and Shellfish)
Conservation Measures
Guam 85
Japanese
Trochus, size limits 42
Recommendations for 83

Crawfish (See Spiny-lobster under Shells and Shellfish)

Culture, Pearl Oyster
Illustrations ..... Fig. 32, 33 44
Map, Palaus-3 36
Marshall Islands, Ebon 72, 73
Palaus 39, 42, 45, 73
Philippines 72

INDEX

Page

Diet, native 2
  Eniwetok 5
  Marianas 55
  Ponape 22
  Truk 33

Dynamite, use of for killing fish
  Ponape 22
  Truk 30

Exports from Mandated Islands 1

Fish, by common names
  Anchovy 33, 55
  Bait 5, 33, 55, 57
  Barracuda 18, 32, 42, 48
  Bonito 8, 25, 33, 42, 50, 55, 56, 75
  Butterfly 7, 10
  Crevalle 7, 21, 22, 25, 32, 33, 42, 48, 50, 55
  Damsel 10, 42
  Flying 10, 30, 55
  Goatfish 5, 7, 10, 13, 21, 25, 32, 33, 42, 55
  Grouper, brown 10, 42
  Mackerel 13
  Manahag (herring ?) 55
  Milkfish 33
  Moorish idol 7
  Mullet 5, 10, 21, 22, 32, 55
  Native names for 89
  Parrot 7, 10, 21, 22, 25, 32, 33, 42, 50, 55
  Poisonous 2, 10, 42, 52, 79
  Scientific and Common names 80
  Remora 32
  Rudder 5
  Shark 5, 32, 55, 57
    On Guam 88
  Snapper (Aprion virescens) 32
  Snapper, red 42
  Squirrel 50
  Swordfish 20
  Surgeon 7, 10, 25, 32, 50, 52
  Threadfish 5, 52
  Trigger 10
  Wahoo 48
  Wrasse 10, 21, 25, 42

Fisheries research, Plan for 86

Fishing Supplies
  Native needs 82
  Shortage of 2, 24, 25, 30, 32, 39, 46, 55

INDEX

Page

Fishing Vessels
  For native use 83
  Japanese 24, 46, 50

Fish Traps
  Bamboo 21, 30
  Other 13, 56
  Stone ..... Fig. 15 ..... 7, 30

Gill Nets 56

Handicraft, native
  Eniwetok 5
  Nukuoro 25
  Ponape 24
  Truk 33

Hand Nets (Epino) 33

Japanese Marine Experiment Station
  Koror, Palaus 48

Jigs, native
  Kayangel Ids. 48
  Nukuoro 25
  Ponape 22

Mussels (See under Shells and Shellfish)

Pearl Oysters
  Culture (See under Culture, pearl oyster)
  Distribution 72
  Gold-lip 72
  Japanese species 73

Poisons, fish
  Derris elliptica 18, 22, 55
  Barringtonia asiatica 18, 22, 55
  Tephrosia purpurea 22

Poisonous Fish (See under Fish)

Population
  Of mandated islands 1
  Of atolls, islands and island groups (See under appropriate heading in table of Contents)

Sea Cucumbers
  Dried (Trepang or Beche-de-mer)
    Palaus 45, 48
    Truk 76

INDEX

Page

Sea Cucumbers (con'd)
- Jaluit 10
- Japanese Production 73
- Kapingamarangi 25
- Likiep 13
- Majuro 15
- Nukuoro 24
- Poisonous 15
- Ponape 20
  - Price of 21
- Preparation for market 42, 76
- Rota 55
- Saipan 50, 52
- Tinian 55
- Truk 32, 76

Seaweed, Edible 5, 52

Seines, Seining
- Ailinglaplap 7
- Eniwetok 5
- Guam 56
- Kapingamarangi 25
- Kayangel Ids. 48
- Kusaie 20
- Nukuoro 25
- Ponape 21, 22
- Saipan 78
- Tinian 52
- Truk 33

Shells and Shellfish
- Anadera (cockle) 24
- Cardium 22, 33
- Cat-eye 18, 21, 22, 48, 55, 56
- Clams
  - Giant ..... Fig. 24 ..... 5, 7, 10, 13, 21, 33, 42, 52
    - Marketing 45
  - Mulefoot 33

Cowries 5, 21, 45, 48, 56

Crabs
- Red (orange)-striped 5, 33
- Samoan ..... Fig. 11 ..... 18, 39

Gold-ringer 5, 10, 24, 32, 33

Helmet 45, 48

Lobster, spiny 5, 13, 18, 24, 25, 32, 39, 48, 50, 52, 55, 56, 57

Monkey-face (money shell) 5, 10, 24, 32, 33, 52

Mussels 10

Octopus 48, 55, 57

Page

Shells and Shellfish (con'd)
Oyster, pearl
Black-lip 11, 31, 32, 34, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79,

INDEX

Page

Trolling (con'd)
By natives (con'd)
Nukuoro 25
By Survey 42, 48

Tuna Fishery, Japanese
For canning 70
Palaus 70
(See Bonito under Fish)

Turtles
Ailinglaplap 7
Fishery 79
Likiep 13
Nukuoro 25
Ponape 21, 22

Twine, net
Native made 7